The Dock and Harbour Authority

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Editorial Comments

Dundee Harbour Development.

In this issue, through the esteemed instrumentality of Mr. Norman Matheson, General Manager and Engineer of Dundee Harbour, we are enabled to present a resumé of the Report on the present condition and future development of the harbour, which, as announced in our last issue, he recently submitted to the Harbour Trustees. The Report was given a cordial reception and the matter referred to a committee to consider the alternative courses propounded by Mr. Matheson, who pointed out that it devolved upon the Trustees to decide at the outset whether they would go in for a policy of reconstruction or a policy of development, since the former would be incompatible with, and would be over-ridden by, the latter.

The committee's recommendation to the Board, which was accepted unanimously and, in our opinion, wisely, was to pursue a policy of development and, accordingly, Mr. Matheson has received further instructions to prepare provisional estimates for works which are outlined as a first instalment and shown on the plan accompanying the article.

The financing of the undertaking presents a problem under present conditions, but the Trustees hope to secure a grant from the Government for the commendable purpose of enabling the port on the Tay to continue and develop its valuable contribution to Scottish overseas commerce. The good wishes of our readers will attend the Trustees in this effort to promote the interests of the port.

Fishery Industry Policy.

Not the least important function of many ports along the British Coastline is the service of the fishery industry. Indeed, in many cases among the smaller harbours, it is the supreme, and even the sole, function. And this service extends to far more than the mere accommodation and berthage of fishing craft: it has to cover all the processes involved in the collection, sorting, marketing and despatch of the catches to inland destinations.

To such harbour authorities and their officials and clients of whatever kind, a knowledge of the conditions under which the industry is carried on and of those by which it may be fostered and developed, is of fundamental importance. We have already recently published an article dealing with a feature of the case which is perhaps scarcely so full appreciated as it might be, viz., the the influence of harbour structures on inshore fisheries. In the present issue we are courteously permitted to reproduce a paper by an authority of the highest standing on a broader aspect of the matter, vitally affecting the interests of the industry as a whole. Depletion of the fishery grounds, from whatever cause, cuts at the root of the industry and the review by Dr. E. S. Russell of the situation, during the present lull produced by war-time conditions, is both serviceable and timely. It is to be hoped that the opportunity after the war, of which he speaks, of adjusting and, if need be, limiting the premissible intensity of fishing operations by international agreement, will be seized, since it will be to the obvious advantage to the fishery industry and of the ports by which it is served.

Southampton in Olden Times.

An article in this issue gives a most interesting and graphic description, presumably from the pen of the great novelist, Charles Dickens, who "conducted" the magazine *Household Words*, in which it appeared, of the port of Southampton as it existed some ninety years ago, that is to say, while still in its original undeveloped condition, though dock works of a minor character had even then just been started. But there was little in the size and extent of these embryo undertakings to indicate the magnitude of the accommodation for shipping which the port would ultimately come to possess. At the time, two tiny basins sufficed for the Lilliputian vessels which visited the port and some amusement will be caused by the pompous epithets which are applied in the article to the notable, though relatively pigmy, ships of those remote days. An outstanding transformation has since taken place in the size and power of the liners which now frequent the port, and while giving due credit to the shipowners, shipbuilders and naval architects responsible for the design and construction of these modern leviathans, no small share of commendation is assignable to the initiative and enterprise of the railway companies which rendered their creation feasible by providing the requisite port accommodation for them. To the London and South-Western Railway Company, who took over the dock system of the port from the Southampton Dock Company, and to their successors, the Southern Railway Company,

Editorial Comments—continued

especially the latter, belongs the credit of having raised Southampton from a position of relative insignificance to the proud eminence of the premier passenger port of the United Kingdom. There is no part of the world where the fame of Southampton has not penetrated, and countless thousands of travellers of all nationalities have passed over its quays in transit to and from the most distant parts of the globe.

The intimate association of the fortunes and destiny of the port of Southampton with two great railway companies leads us, at a time when public attention is being directed to the question of port administration and its possibly more efficient direction under a scheme of national co-ordination, to make some observations on the subject of railway control of ports.

Railway Ownership of Ports.

It is the proud boast of British Railways in some of their latest propaganda literature, that they are the largest dock owners in the world; that is to say, that they exercise jurisdiction over a larger area of impounded water area at ports, with the attendant peripheral quayage, than any other form of administration in the British Isles. Without entering into a discussion on the ideal system, a question which naturally arises is: Is railway control a commendable form of port administration or is it desirable to substitute some other system. With a slight variation in terms such a question can be stated in two parts: (a) has railway control of port affairs proved itself to be a sound and efficient method and, if so, (b) are there grounds for disturbing an arrangement which is working satisfactorily.

As to the first part of the question, there can be little doubt as to the justice of an affirmative answer. Speaking generally, the railway companies of this country have administered their dock systems in a highly creditable manner and with business-like efficiency. Southampton is a shining and conspicuous example, though by no means the only one among a group of ports of the foremost rank maintained by British railways. The Royal Commission on Transport in their Final Report (1931) paid a high and well-deserved tribute to the port and its administrators, stating: " We believe its wonderful development in recent years has been due to the enterprise of the London and South-Western (now Southern) Railway." It is only fair to the Southampton Harbour Board to insert a reminder that they are, and have been, responsible for the seaward approach to the port and the maintenance of the channel fairway.

The first question having been answered affirmatively, the next query (b) is to whether adequate grounds exist for making any change. The Royal Commission were not without doubts on this point, despite the fact that they did not commend railway control as an ideal form of port administration and, indeed, conveyed a trenchant criticism by expressing their opinion that, in principle, it was undesirable that one form of transport should own docks and harbours to which access by other forms of transport was essential. " When we consider," they said, " the character of the great majority of the railway-owned docks and harbours, we are not at all certain that it would be to the advantage of the public that they should be transferred from their present ownership."

The question is, undoubtedly, beset with complexities, for the interests of a railway company and its shareholders are not necessarily identical with those of the community at large, nor, indeed, with those of the port administered. At times, they may even be in conflict. The main consideration of a railway company is to secure traffic for its lines and the fostering of the trade of a port under railway control is obviously subservient to this end. Railway companies can hardly be expected to adopt an altruistic attitude towards transport which does not feed their systems and they may even be tempted unfairly to adjust their rates to suit potential customers, so as to attract consignment of goods from other competitive ports. Such are possibilities which must be taken into account in any dispassionate view of the situation. But it cannot be said that British railway companies have abused their powers. In the light of existing circumstances, the non-committal verdict of the Transport Commission is, perhaps, the fairest permissible reply to the question.

Coal Trimmers as Dock Labourers.

At the beginning of May an arrangement came into force by which coal trimmers at certain ports on the North-east Coast became available for work as ordinary labourers under the Dock Labour Corporation. The move had been in contemplation for some time; since, in fact, a little more than a year ago, when the first step was taken by scheduling the men under an Essential Work (Dock Labour) Order. Various points, however, in regard to hours and payments, customs and practices, have had to be examined and decided before the scheme could be completely adopted, and now that it has actually come into operation, it still remains to be seen how far an amalgamation of diverse duties will prove a satisfactory arrangement.

Coal trimming is, of course, a special class of port work and is perhaps, not quite so strenuous and exacting as general cargo handling. A less robust class of men suffices for the job. As a matter of fact on the East Coast, the average age of coal trimmers is stated to be higher than that of ordinary labourers, quite a number of them being over 60 Apart from this, there is a natural sense of dissociation between the two services which will have to be overcome if good results are to be achieved.

For the trimmers the advantage lies in the financial arrangement by which they become eligible for a guaranteed minimum wage of 66s. per week. even when there is no work available for them. On the other hand, they are liable to be transferred from their home port to some other locality as necessity dictates. The men, unaccustomed to change, do not seem altogether to relish this prospect. Work at North-east Coast coal staiths, however, is at present fairly regular and it is unlikely, while this is the case, that coaling operations will be interrupted unless a state of emergency should arise.

Comment on the industrial utility of the move is necessarily influenced by the fact that it is a war-time measure and therefore governed by considerations of expediency rather than of economics. It can hardly be regarded as other than a temporary arrangement.

The Tunisian Ports.

The dramatic, not to say sensational, capture by a surprise concerted attack on May 7th of the two famous Tunisian ports of Tunis and Bizerta, suggests the propriety of giving some detailed particulars of the harbour accommodation and facilities thereby placed at the disposal of the United Nations.

Located in an extremely favourable strategic position adjacent to the entrance to the Sicilian Channel, which it commands from the African littoral, Bizerta is primarily and predominantly a naval base, although it also possesses a commercial port, where, prior to the war, some amount of business (principally in coal, fuel oil, grain, wine and ores) was carried on. The depth at the harbour entrance was formerly 33-ft., but this was in process of being increased to 40-ft. as far as the entrance to Bizerta Lake, an inland sheet of water, able to accommodate and shelter a considerable volume of tonnage. The outer harbour, 230 acres in extent, is protected by two artificial piers or moles, each 3,300-ft. long and by a detached breakwater. Internally, there is quayage of 1,300 lin. ft. with a depth of 30-ft. alongside.

Somewhat less than 40 miles from Bizerta in a South-eastern direction, lies the land-locked port of Tunis, the capital of Tunisia. It has an outer annexe at La Goulette in the Gulf of Tunis, the two being connected by a navigable channel, 6½ miles long and 90 yards wide, dredged to 23-ft. The harbour of La Goulette has a depth of 28-ft., though vessels can load and discharge in the roadstead in depths of from 30 to 50-ft. There are two inner basins with a combined surface area of 62 acres. At Tunis, the number of basins is three, with a surface area of 84 acres and 5,700 lin. ft. of quayage, affording berthage for vessels of up to 20-ft. draft. The commerce of Tunis has been considerable, embracing imports of woollen and cotton stuffs, hardware, provisions, machinery, hides, timber and coal; and exports of phosphates, iron and lead ores, sponges, dates, olive oil, cereals and wine. Tunisian dates are esteemed the finest on the European market.

The Harbour of Dundee

A Review of the Present Condition and Future Development of the Port

Based on a Recent Report by NORMAN A. MATHESON, Assoc.M.Inst.C.E., General Manager and Engineer

Historical

THE Centenary of the Constitution of The Dundee Harbour Trust was celebrated in June, 1930. For the past 113 years, the City of Dundee— Third City of Scotland, with a present-day population of over 180,000— has been served by a harbour which, during these years has continuously increased in importance and in accommodation.

The greater part of the increase took place between the years 1830 and 1909, during which the following works were constructed:—

West Tidal Harbour, and completion of Earl Grey Dock (1830-1849);
Camperdown Dock (1865);
Victoria Dock and East Dry Dock (1875);
Western Wharf (1881-1891);
Eastern Wharf—Western (Timber) Section (1895);
Fish Dock (1900);
Eastern Wharf—Eastern (Reinforced Concrete) Section (1909).

Since 1909, the King George V Wharf has been constructed, the work being completed in three sections:

The First Section, 630 feet long (1913);
The Second Section, 255 feet long (1926); and
The Third Section 605 feet long (1931).

This wharf is a fine example of modern reinforced concrete construction and is admirably suited to the needs of the harbour and its users. It can accommodate the largest vessels using the harbour, and the shed and crane facilities are well devised for the quick and easy handling of goods.

It is unnecessary to enter into details of the existing harbour works, except to point out that, with the exception of King George V Wharf, the whole of the constructional works carried out during the past 113 years were completed by 1909.

Mr. NORMAN A. MATHESON,
Assoc.M.Inst.C.E., M.Inst.T.

As the King George V. Wharf represents less than 10 per cent. of the total berthage at the harbour, it is apparent that by far the greater part of the works were designed to deal with vessels of smaller types, particularly in regard to breadth and draft, than are in general use at the present day.

Although it may be shown that the harbour has extended as its trade has increased, there is, unfortunately, a difficulty which is not overcome by the provision of a *pro rata* increase of accommodation to traffic.

While the traffic at any port may have increased by, say, 10 per cent. during the past 25 years, as against an increase of, say, 50 per cent. during the preceding 75 years, the works designed to take the older types of vessels are now called upon to take also the newer types for which they are often totally unsuited.

This applies to all harbour works, including dry docks.

It is true that, generally speaking, the older works, originally designed for the deep sea trade, are now turned over for the use of coasting traffic, but even present-day coasting vessels are frequently too great in beam or draft to be adequately served in these berths and docks.

It was with this in mind that the Dundee Harbour Trustees, on the motion of one of their members (Mr. Henry Main), gave instructions for a report to be prepared on the possibilities of development at the harbour.

The report was recently submitted to the Trustees and the remainder of this article sets out the principal features contained therein.

It will be found helpful if frequent reference is made to the plans which accompany the article.

I. Existing Harbour Works: Present Condition

The first section of the report sets out in general terms the present condition of the harbour works, giving dates and brief details of construction and dealing with matters such as shed accommodation, cargo-handling equipment, railways, etc. The principal point is that King George V. Wharf is described as "the only modern section of the harbour, and the only section capable of accommodating large fully-laden vessels"; and further, that "its length of 1,490-ft. is, however, on occasion sufficient for only two such vessels.

Attention is also drawn to the following points:—

The Eastern and Western Wharves will require reconstruction in the near future unless they are replaced by alternative accommodation.

The Camperdown and Victoria Docks are restricted in usefulness for handling coastal vessels on account of the depths and widths of the entrances.

The closing caisson which serves to retain the water in both Camperdown and Victoria Docks will require early renewal.

Because of the dimensions of the Camperdown and Victoria Dock Entrances, and also of its own entrance, the East Dry Dock is not capable of dealing with the larger types of vessels which use the Port.

The condition of the Fish Dock is also described as becoming rather unsatisfactory.

II. Existing Harbour Works—Possible Reconstructions and Improvements

The report goes on to deal with what might be done, and what can be done, by way of reconstructing and improving the existing works, apart altogether from the larger question of development.

River Wharves: Two of the present river wharves must receive considerable attention.

The Western Wharf could be rebuilt on its present site: it could possibly be given an increased depth alongside, but due to the rocks which lie just off the wharf, it could not be appreciably widened or extended. Accordingly, there could be no material increase in berthage, and it is doubtful, on account of the restricted land space, what increase could be provided as regards shed, rail and cargo-handling facilities.

The **Eastern Wharf,** on the other hand, lends itself admirably to any work of reconstruction. It could be widened, straight-

The Harbour of Dundee—continued

ened, and to some extent lengthened. New up-to-date sheds could be erected, or the present sheds enlarged and improved. Adequate rail and cargo-handling facilities could also be introduced in a reconstruction work.

Nevertheless, on completion of the work there would be additional accommodation for—at most—one vessel, and even this might not always be possible.

Wet Docks: Even if it were considered worth while, little could be done to improve the Earl Grey Dock.

There is also little that could be done in the way of reconstruction and improvement of the Camperdown and Victoria Docks—largely because of the restricted areas in which they lie. They could, no doubt, be deepened in parts, and the entrances somewhat improved, but the provision of extra berthage seems a practical impossibility. Further, the deepening—in addition to being comparatively costly—would entail an encroachment on the present water area, and would, therefore, have to be limited in its extent; at the same time any such encroachment would possibly hamper the movements of vessels in the docks.

Certain improvements in shed and cargo-handling facilities could be effected—a very desirable feature of any work at this section of the harbour.

A pressing need is the provision of a new Closing Caisson at Camperdown Dock Entrance.

Fish Dock: Possibly the most suitable method of reconstructing this dock would be to enclose the existing timberwork behind a wall of sheet piling, the work being carried out in short sections as the need arises.

Dry Docks: When the West Dock is filled in, there will remain only the East Dock and the Patent Slip.

The latter facility is not capable of any real improvement, and all that can be done is to keep it in a good state of repair.

The East Dock, due to its site and the nature of its construction would appear incapable of any improvement which would permit it to deal with modern ocean-going vessels.

Summary

The position may, therefore, be summed up in the following terms:—

(1) The Eastern and Western Wharves are in need of, and are capable of, reconstruction on improved lines, but will provide little additional berthage.
(2) The Camperdown and Victoria Docks could, to a limited extent, be improved, but could not be extended.
(3) A new closing caisson will have to be provided for the Camperdown Dock Entrance.
(4) The Fish Dock will require increasing maintenance attention and, finally, reconstruction.
(5) Any improvement of existing dry dock facilities is not a practical proposition.
(6) The provision of cargo-handling equipment at the wharves and docks should receive attention.
(7) The railway system is not particularly satisfactory, this being due to lack of land space.
(8) There is an item which will be dealt with in Section III but which must also receive consideration here—namely, the provision of dredging plant capable of maintaining deep water at the Bar and in the Navigable Channel.

III. Possible Development of the Harbour

Apart from the possibility of developing the harbour, there must first be the necessity for development.

In present circumstances, it would be rash to prophesy on this point and there are accordingly two precepts which must be kept in mind:—

(1) Any scheme of development must be such that, while providing adequate facilities for immediate needs, it can be adjusted to suit future requirements as these become known.
(2) Each stage of development must form part of a co-ordinated plan, bearing a definite relation to what had been done before, and what might have to be done in the future.

Many harbours have suffered as a result of "piecemeal" construction; wharves and other works have been constructed one by one with an eye to immediate requirements only, and little or no consideration given as to how each part would fit in with future works.

In other words, the problem must be viewed in a broader fashion than the satisfying of current needs by methods which in later years would earn the criticism of being "short-sighted" and serve to prevent or hamper future opportunities for development.

The report suggests that the main points which should receive consideration in drawing up a Development Scheme for Dundee Harbour are:—

(a) The provision of wharfage to replace the present Eastern and Western Wharves; this wharfage to give accommodation at least equal to the existing wharves as regards length, and improved as regards depth, shed and rail facilities, etc.
(b) The provision of powerful dredging plant, suitable for work at the river mouth and in the navigable channel. This is one of the principal matters affecting the Port, and should receive the most careful consideration apart from any question of general development.
(c) The provision of modern dry-docking facilities, capable of taking the largest type of vessel likely to use the Port. (It is perhaps advisable to point out that whereas the present dry docks have become inadequate because vessels have increased in size since the time the docks were built, there is not so much likelihood of a modern dock becoming obsolete if it is built to take the largest vessel which can use the channel).
(d) The provision of improved facilities for coastal traffic—even to the extent of the ultimate construction of a new dock for this traffic, since the available existing land area is too restricted to allow any real improvement of the present docks.
(e) The wharfage referred to under (a) to be of such a form as to be capable of considerable extension if found necessary at any time.
(f) The provision of adequate railway facilities throughout the harbour.

The area at Stannergate is the only part of the Harbour Estate meantime undeveloped, and it would be quite practicable to construct a new river wharf there, and also, possibly, a dry dock. On account of its shape, however, the area is not particularly suitable.

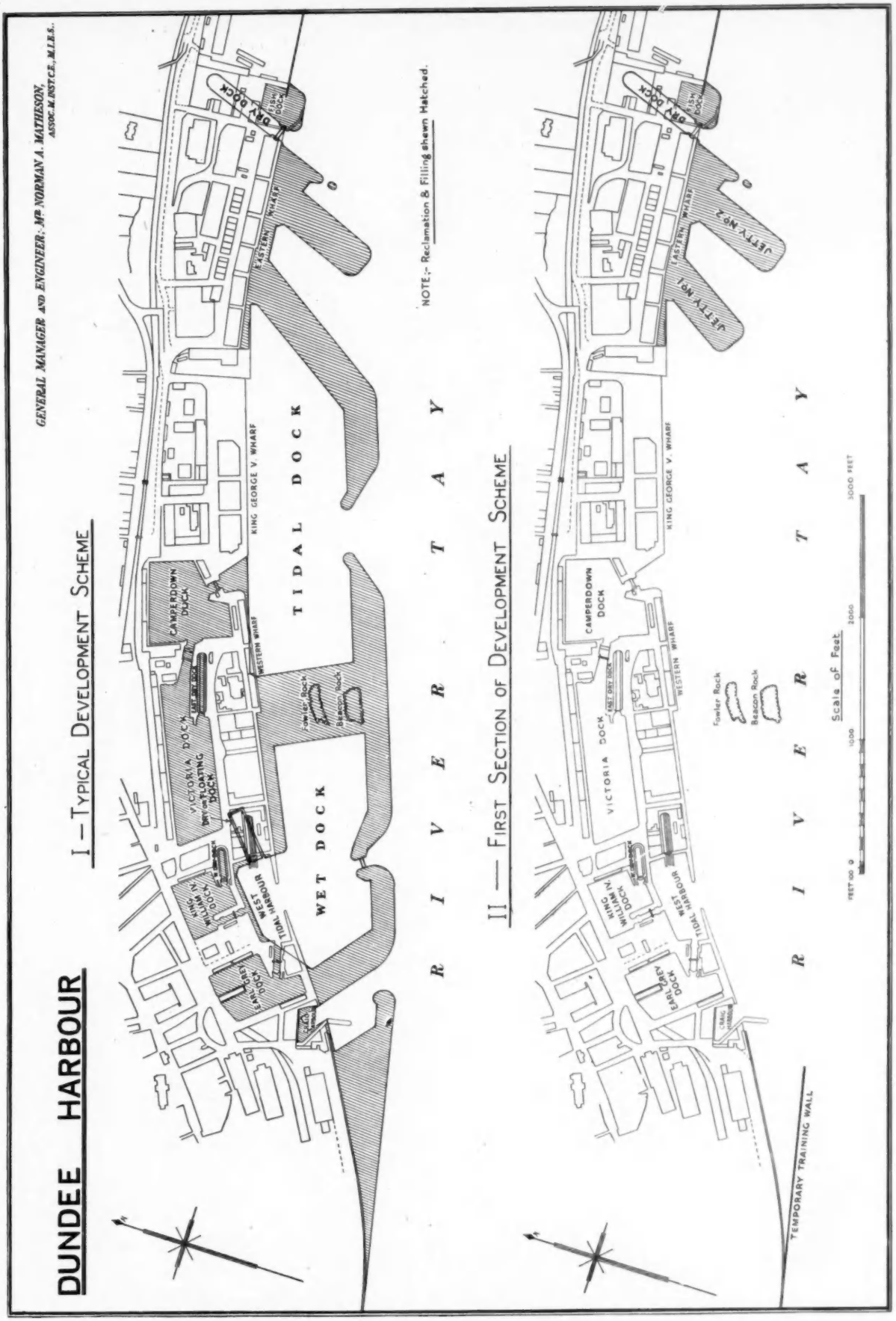
An even greater objection is the fact that once this area has been used the harbour has no further space for extension.

To utilise the Stannergate area would provide some immediate development. It would also close the door against "development" in the real sense of the word.

It will be obvious that many schemes can be devised and it should be emphasised that the particular scheme outlined hereafter and on the accompanying drawings is merely one proposal—put forward as a starting point for discussion, and its author is as fully aware as anyone that it is capable of great improvement, and will, in any case, require amendment to ensure of its meeting the changes in requirements of trade and shipping which will undoubtedly take place during the long period of its construction.

After pointing out that the Trustees must, as a first step, decide between policies of reconstruction and development, the report goes on to suggest that in the event of a decision in favour of development the initial works must be in the form of berthage to take the place of the present Eastern and Western Wharves.

This new berthage might be in the nature of a jetty, having its landward end based on the timber (Western) section of the present Eastern Wharf, and extending to the river at an angle suitable for the convenient handling of vessels. The jetty would be constructed so as to give berthage on both sides, and cargo sheds would probably be of the two-storey or three-storey type. The jetty would have the double effect of providing improved—but not necessarily additional—berthage, and of covering in the most unsatisfactory section of the existing wharf. The river end of the jetty would be constructed so as to permit of extension.


DUNDEE HARBOUR
GENERAL MANAGER AND ENGINEER: MR. NORMAN A. MATHESON, ASSOC.M.INST.C.E., M.I.E.S.
I — TYPICAL DEVELOPMENT SCHEME
II — FIRST SECTION OF DEVELOPMENT SCHEME
NOTE:- Reclamation & Filling shewn Hatched.
RIVER TAY
TIDAL DOCK
WET DOCK
CAMPERDOWN DOCK
VICTORIA DOCK
KING GEORGE V WHARF
WESTERN WHARF
EASTERN WHARF
DRY DOCK
JETTY No 1
JETTY No 2
Fowler Rock
Beacon Rock
EARL GREY DOCK
WEST TIDAL HARBOUR
TEMPORARY TRAINING WALL
Scale of Feet
FEET 0 1000 2000 3000 FEET

The Harbour of Dundee—continued

Next might come the construction of a second jetty—with its landward end based on the concrete (Eastern) section of the present wharf—of a form similar to the first jetty but having its eastern side extended landwards to provide a lead-in to a dry dock constructed on the site of the existing Fish Dock.

The dry dock should at least be capable of taking a vessel 600-ft. long, and the other principal dimensions should be approximately: Width of entrance not less than 80-ft.; depth over blocks at high water of ordinary spring tides, 25-30-ft.

Once this stage of development has been reached, the requirements set out in sub-headings (a) and (c) of this section of the report would be fulfilled.

The provision of dredging plant is regarded as a matter which should receive attention as promptly as possible.

On completion of this, the " First Section " of the Development Scheme, it is essential that the works should be in such a form that a halt can be made to consider what extension, if any, is required at the time of completion to meet requirements of trade.

It should be noted that the " First Section " is not, in effect, a development but merely a re-arrangement of existing berthage in a form which will allow for development if required.

The necessity of being able to stop the works at this stage brings into prominence one of the most vital preliminaries to any scheme of development—namely, that the scheme must first be tested, by means of experimental models and otherwise, to ensure that at no stage of its construction or on its completion will it have serious permanent effects on the river as a whole which would either render navigation difficult or necessitate enormous maintenance expenditure.

Only if it can be demonstrated that this danger is non-existent or avoidable, would it be permissible to proceed with the proposals previously outlined and the further extension of these proposals.

On the assumption that satisfactory evidence has been obtained, development might then proceed in the following fashion—always bearing in mind that the scheme is not for immediate and continuous execution but for completion in several stages over a long period of time.

The Beacon and Fowler Rocks might be enclosed between quay walls, the eastern wall forming part of a tidal deep-water harbour along with the jetty (extended) constructed as the first part of the scheme, and the western wall forming part of a wet dock extending to some point approximately opposite the west side of the existing Tidal Harbour and entrance to Earl Grey Dock. The wet dock would be completed by forming a river-wall extending eastwards from a point west of Craig Pier, this giving a straight course for the river. Inside the wet dock there would probably require to be a moderate-sized dry or floating dock. Arms stretching to West and East of the Beacon Rock would form the entrances to the wet dock and the tidal deep-water harbour.

On its completion, the Wet Dock would replace the Victoria and Camperdown Docks which could then be closed by extending the King George V. Wharf westwards to meet the wall enclosing the Rocks

The ultimate filling-in of the existing wet docks (including the Earl Grey Dock) would provide invaluable land area for industrial and other purposes and ensure space for adequate rail facilities and general harbour needs.

When dealing with such a long-term scheme it must be remembered that, among other matters, it would be necessary from time to time to carry out certain work to existing structures—for example, a new closing caisson would be required for the Camperdown Dock. Such work should not, and need not, be wasteful. Thus, if a new caisson—it would probably be the second or third one—had to be provided within, say, 20 years of the expected date of completion of the new Wet Dock, then that particular caisson could be constructed to give approximately that length of service, and so its initial cost would be lessened.

A fishing and a small-boat harbour would have to be provided, and a suitable site would probably be to the west of the new Wet Dock, nearly opposite Craig Pier. This harbour would also have to be capable of dealing with the Tay Ferries traffic.

The scheme outlined above (and subject always to satisfactory proof that at no stage would it produce ill-effects on the river or existing harbour works), would ensure scope for harbour development over a very long period without the necessity for building eastwards, unless the requirements of some particular industry or traffic make this advisable and profitable.

It is perhaps unnecessary to point out that, before any scheme could be drawn up, a great deal of preliminary research in the way of trial borings, etc., would have to carried out, in addition to the experiments with tidal models to which reference has already been made.

It will be seen that stress is being laid on the necessity for ensuring that no matter at what stage construction may have to be stopped, no harmful effects will be experienced. Since almost inevitably there would be comparatively long intervals between the various stages of the works, the importance of this precaution cannot be over-rated.

IV. Conclusion

The final section of the report is in the form of a summary.

It states that a number of existing works require reconstruction and can quite well be reconstructed to give considerable improvement over existing conditions.

Such works as do not require complete reconstruction can also be improved to a greater or lesser extent with the exception of dry-docking facilities.

If, however, a policy of reconstruction is adopted, it must be realised that future opportunities for development, should these occur, would be seriously handicapped both from the financial and physical standpoints.

Trade and its satellite finance, are the factors which would enable a choice to be made, could one but see far enough ahead. In an attempt to meet the Unseen, it is laid down as one of the Principles of Development that any scheme must start off by providing a replacement of facilities which would in any event require reconstruction, and thereafter be capable of considerable extension and amendment to meet possible increases and changes in trade and shipping.

Dundee is not a dead or dying Port. It serves a large district; a district which, it is hoped, will in the future play a more important part in the industrial affairs of the country than it has done in the past.

The harbour has contributed to the prosperity and growth of the City of Dundee, and the converse is also true. City and harbour are linked together in a joint interest. Both are anxious to pursue a progressive policy which will result in benefit to their communities and to the country generally.

It is realised that to make plans in the middle of a world war is to invite disappointment and to see labour lost. It is still more fully realised that not to make plans is to invite disaster. What the state of the country's harbours will be after the war no one can foretell. Existing forms of control may be radically altered; trade may be bad; repairs to works held up by war conditions may prove a heavy drain on finances. But these are not sufficient reasons to justify a policy of inactivity. Our nation has always been dependent on its harbours. It is likely to be dependent on them for many years to come.

Accordingly anyone who does not expect to see a thriving harbour does not expect to see a thriving community round about it; there is an admission of loss of faith in the future of this country.

It is indicative of the spirit of Dundee that since the report, summarised in this article, was submitted, the Harbour Trustees —fully aware of present and future difficulties—have announced that they favour a policy of development in preference to a policy of reconstruction, and have given instructions for preliminary investigations to be made on these lines.

Proposed Japanese Canal.

A proposal is being put forward by Japanese engineers to connect the Sea of Japan with the Pacific by means of a waterway from Tsuruga, of Obama, on the former with Osaka, through Lake Biwa. It would accommodate 5,000-ton vessels, cost about 2 million sterling and take five years to complete.

Port of London Authority Board Room

Through the courtesy of the Port of London Authority we are able to reproduce from the April issue of the *P.L.A. Monthly* an extremely interesting photograph of the Board Room at the Head Office of the Authority. It was taken during the Board meeting on February 25th last, and the following is a list of the members present:—

[Fox Photos

The Board Room of the Port of London Authority.

On the right of the Chairman, the Rt. Hon. Thomas Wiles, P.C., and following the horse-shoe lay-out of the desks, are: Mr. L. H. Bolton, Vice-Chairman; Sir Douglas Ritchie, M.C., General Manager; Capt. Sir Ion Hamilton Benn, Bart., C.B., D.S.O., T.D.; Mr. W. C. Warwick; The Rt. Hon. Lord Rochester, C.M.G.; Vice-Admiral Sir J. A. Edgell, K.B.E., C.B.; Mr. J. T. Scoulding, J.P.; Mr. D. W. Large; Mr. A. Galloway, J.P.; Mr. A. K. Graham; Mr. P. Wharton; Mr. R. Kelso; Mr. R. T. Garrett; Mr. H. E. Miller; Mr. C. W. Hodge; Colonel A. C. Davis, D.L., J.P.; Sir Bertram Galer, D.L., J.P.; Capt. A. H. Ryley; Admiral Sir Alan G. Hotham, K.C.M.G., C.B.; Mr. E. A. Lloyd; Mr. W. J. Clarke; Mr. O. H. Smith; Sir Arthur Cory-Wright, Bart., J.P., and Mr. A. B. Huggins, Acting Secretary.

This is the first photograph taken of the Board in Session since the inauguration of the Authority in 1909, and it also happened to be the occasion of the opening and inspection of the contents of the two bottles found in the recently discovered foundation stone at the West India Docks, which was laid on July 12th, 1800.

The following is a description of the Board Room as given in the *P.L.A. Monthly*:—

The Board Room, which shows a few war-time scars and from which certain appurtenances have been removed for the duration, is one of the fine features of the head office building. It is sixty feet long and thirty-eight feet wide and thirty feet in height. The walls are treated with rich dark brown English and French walnut, and the deep cove and ceiling over are in white plaster. On each side, in this cove, are lunettes with glazed copper grilles which light the whole room in a most effective manner. The architectural treatment is in the Corinthian style. Coupled, fluted, and reeded pilasters are arranged around the walls, and between them occur the five windows on one side and central doorways at either end. The walls are in large "quartered" panels of beautifully grained French walnut veneer. The exquisite carving of the capitals and of all the super-imposed ornament on the walnut is of lime-wood and is already toning down to a beautiful colour, which will greatly enhance its effect. At one end of the room is a medallion portrait of Chaucer, once a servant of the Port and at the other is that of Pepys.

The building was designed by and erected under the supervision of the late Sir Edwin Cooper, F.R.I.B.A.

Obituary.

The late **Mr. Joah Haigh Walker,** M.Inst.C.E., whose death at the age of 68 took place in April, was for 12 years (1912-1924) in the service of the Port of London Authority, first as an Assistant Engineer, and subsequently as Resident Engineer, on dock improvement works at Silvertown. During this period he patented a system of reinforcement for concrete road (afterwards sold to a private company), also a cableway crane and a new type of nozzle to improve the tonnage capacity of floating grain plant.

Port of London Authority and City Reconstruction Council.

The chairman of the Port of London Authority, the Right Hon. Thomas Wiles, has been appointed to represent the Authority on the City of London Reconstruction Advisory Council, a body formed to advise the Corporation of London on the needs of the principal financial, mercantile and other institutions and to co-ordinate City opinion on problems connected with reconstruction. The Secretary of the Council is Mr. A. E. Wildey, formerly Public Relations Officer of the Port Authority.

Harbour Breakwaters*

By MARCIANO MARTINEZ CATENA, Engineer of Roads, Canals and Harbours.

I.—Mound Breakwaters

(Concluded from page 7)

The stability of the breakwater, as we have said, depends on the principal protective covering, and its slope and the weight of stone composing it, constitute the chief factors.

The weight of the pieces of the covering in kilogrammes are given in the following formulæ:

According to Iribarren:

$$P_i = \frac{K\,A^3\,d}{(\cos\alpha - \sin\alpha)^3\,(d-1)^3}$$

According to Castro:

$$P_c = \frac{704\,A^3\,d}{(\cot\alpha + 1)^3\sqrt{\cot\alpha - \frac{2}{d}} \times (d-1)^3}$$

In the foregoing expressions, the symbols have the following signification:

K is a constant which = 19 when the elements are artificial blocks and 15 when they are rubble.

A = The amplitude 2h of the wave in metres; d = density of the rubble or of the blocks; α = angle made by the slope with the horizontal.

These two formulas give most inconsistent results. Dividing the first by the second:

$$Z = \frac{P_i}{P_c} = \frac{K\,(\cot\alpha + 1)^3\sqrt{\cot\alpha - \frac{2}{d}}}{704\,(\cos\alpha - \sin\alpha)^3}$$

Let us see the values of Z in the more frequent practical cases with slopes of 3:2; 2:1; 3:1; and 4:1, the elements being natural stone or artificial blocks.

Slope, 3:2		
When	K = 15, d = 2.6	Z = 5.3
	K = 19, d = 2.2	Z = 6.0
Slope, 2:1		
When	K = 15, d = 2.6	Z = 2.3
	K = 19, d = 2.2	Z = 2.8
Slope, 3:1		
When	K = 15, d = 2.6	Z = 2.0
	K = 19, d = 2.2	Z = 2.4
Slope, 4:1		
When	K = 15, d = 2.6	Z = 2.4
	K = 19, d = 2.2	Z = 3.0

That is to say, in corresponding circumstances, in the case in which are formulæ most closely approximate to one another, the weight of the elements, determined by Iribarren's formula, is double that by Castro's formula. The two formulæ which the respective authors certify as close approximations to the truth, are incompatible; prudence and the structure of the formula, as also his theoretical reasoning, induce us to adopt Iribarren's formula as a first approximation, without prejudice to comparison as regards the slope and weight obtained with other breakwaters already constructed and exposed to seas which produce like characteristics to those adopted in the design. Possibly experience of well-constructed breakwaters will advise some compression of the slope, above all if the berm, sketched in the diagram, is adopted, of which more will be said later, and the covering is formed from below upwards, adjusting the rubble or blocks, which is not customary in practice, where it frequently happens that the rubble slips, with the result that the pieces are unstable and, on the breaking of the waves, change the face of the slope.

*Translated from the Spanish Article, "Diques de Abrigo en Puertos," in the *Revista de Obras Publicas*, July, 1941.

The levels to which the slopes are to be prolonged can be estimated at 2h below low water spring tides and $\frac{3h}{2}$ above high water springs, assuming a tidal sea for generalisation.

Let us consider these levels further.

The waves, propagating in indefinite depths, obey the laws which hydrodynamics has fixed for trochoidal movement.* Their free surface is a trochoid. The molecules describe circular orbits of radius r, varying with the depth following a logarythmic curve. The radius of the circle described by the surface molecule is

$$r = h$$

The semi-period of the wave is

$$T = \sqrt{\frac{\pi L}{g}}$$

When propagation takes place in finite depths, the circles become transformed into ellipses; the semi-axis of which for the surface molecule is

$$r = h.\ \cot h\frac{\pi H}{L} \qquad \text{.....(a)}$$

The semi-period is given by

$$T = \sqrt{\frac{\pi L}{g}\cot h\frac{\pi H}{L}} \qquad \text{.....(b)}$$

Since the periods are equal, seeing that in equal times an equal number of waves pass a given point, a reduction in H in formula (b) (T remaining constant) means a diminution in L and an increase in $\cot h\frac{\pi H}{L}$. Similarly, in formula (a) by keeping h constant, r is augmented. The wave, therefore, propagated in shallow water, lessens in length and increases in height. The wave breaks when the surface trochoid is transformed into a cycloid, that is to say, when

$$2\pi r = 2L \qquad \text{.....(c)}$$

Eliminating r and L between the formulas (a), (b) and (c) we obtain the depth in which the wave breaks in terms of period and amplitude.

$$H_r = \frac{T\sqrt{gh}}{2\pi}\,Lg\,\frac{T\sqrt{g} + \pi\sqrt{h}}{T\sqrt{g} - \pi\sqrt{h}}$$

H_r is always less than 2h.

Consequently, the slope must be continued down to a depth H_r with which arrangement we should be on the safe side. Taking into consideration that, practically, the wave breaks a little beforehand, due to the fall of the spray of the preceding wave forestalling the breaking of that which follows; that in maritime works there is no factor of safety, and, finally, the advantage of a firm support outside the zone of maximum influence of the breaking wave, the slope is prolonged down to the depth 2h, not forgetting that these preceding calculations are in accordance with practice when depths decrease by degrees, except that the wave breaks beforehand, although with less energy than when the depths decrease abruptly; it suffices to recall, in connection with this, the frequent phenomenon of breakers at a distance from the coast through the existence of shoals, breakers which are produced by waves of height equal and at times less than the depth of the shoal.

*See *Annales des Ponts et Chaussées*, year 1888. "Concerning swell and reflected waves," (De la houle et du clapotis) by Barré de Saint Venant and Flamant.

Harbour Breakwaters—continued

Let us see the level above water up to which the slope is to be extended.

The theoretical conversion of the trochoid into a cycloid will also serve as a relationship. The super-elevation of the mean level of the trochoid, propagating itself in finite depths H, over the level of repose is

$$h_o = \frac{\pi\, h^2 \cot h \frac{\pi H}{L}}{2L}$$

and since

$$2L = 2\pi r \text{ and } r = h \cot h \frac{\pi H}{L}$$

by substitution we obtain

$$h_o = \frac{h}{2}$$

and the crest of the wave remaining at a height h above that level, this will be at $\frac{3h}{2}$ above the level of repose. At this level we cut the slope, not forgetting as we have previously remarked, that the wave will probably break before the calculated point and the crest will not be so much raised. In order to prevent the surf from passing the top, a parapet is arranged, concerning which we will speak later.

This completes the design for the principal protective covering

(b) **Secondary Protective Coverings.**—These are shown in m and n in Figs. 1 and 2. If the principal protective covering is arranged directly over the core, the breaking of the wave, accompanied by the consequent turbulence, will by entering the large vacuities in the pieces forming the protective covering level the more minute particles of the core, and at length, will terminate in producing first, important settlements with consequent alteration of the slope, and then its deformation with consequent danger to the breakwater.

In order to avoid this, below the principal protective covering are arranged other classifications of rubble, from large to small, from the surface down to the core, which acting the part of a sieve, and affording mutual protection, prevent the propagation of the turbulent movement produced in the breaking of the wave and thus avoid the washing out of the minute particles in the core, so contributing to the stability of the work.

These coverings are prolonged below the principal protection, forming a ledge which serves as a support thereto and continue with a steeper slope down to the bottom where the water is quiescent.

The same coverings are arranged also for the parapet of the harbour, resulting in the breaking of the least surge that can be produced in the interior part of the bay, on the chief protective covering. It is obvious that at the side of the harbour, the protection can be less so that the number of coverings is fewer.

In the diagrams, secondary coverings have been indicated. In more sheltered positions, one of them can be dispensed with, with consequential economy but where the sea beats most intensely and the quarry lends itself to more categories of stone, more than two coverings may be adopted.

Sections of breakwaters are not frequently come across in which in the external parapet and at the change of slope there is a berm as shown in the diagrams. Although this somewhat enhances the cost of the work, we consider it very convenient, since it affords considerable support to the principal covering and in case of having to make a replenishment of rubble, it facilitates, and is a safeguard for, the operation.

It has been a frequent practice in some Spanish ports to arrange in the principal protective covering classified material mixed in different proportions. We think it is a mischievous practice for the following reasons: (a) If the smallest fragments of classified rubble of less weight are stable in the said slope, there is no reason for including with them pieces of much greater weight, which enhances the cost of the work in having to arrange the auxiliary pieces, involving movement of the heavier pieces. (b) It is uneconomical to classify the rubble at the quarry in order to mix it forthwith at the work. (c) It is difficult to fix an exact standard by which to know how to mix the rubble in the assigned proportions. The most weighty reason to justify the mixing is that the lightest rubble fills the superficial vacuities in the heavier, preventing the washing out of the minute material in the core, which can be avoided in our judgment by arranging the covering or coverings which we have termed secondary. Really, that which happens in works, which, having made this admixture, has attained stability through the sea not washing away the lesser particles of minor weight, is that the slope adopted has become excessively flat through the bulkiness of the rockwork, which undoubtedly has resulted eventually in an undue expenditure on the breakwater. And it should not be forgotten that if the most minute pieces have been incorporated in the larger, these ought always to be compacted and not deposited roughly, as is frequently the case in the majority of these works.

3. **Ridge or Parapet.**—In the two diagrams there are shown parapets with coping at the level $\frac{5}{2}$ h above high water to prevent the spray produced by the breaking waves from reaching the breakwater promenade.

This is not indispensable, since the effect can be achieved by extending the slope of the principal covering at the same level; but, in general, there is greater economy in the section with a parapet, especially in adopting the very convenient arrangement of a roadway for service and upkeep of the breakwater.

The two diagrams are based on hypothetical breakwaters.

Fig. 1 is the cross-section of a breakwater exposed to waves of 8 metres amplitude.

Taking 3:1 as the slope of the principal protective covering, the weight of the blocks forming it will be:

$$P = \frac{19 \times 8^3 \times 2.2}{\left[\frac{3}{\sqrt{10}} - \frac{1}{\sqrt{10}}\right]^3 [2.2 - 1]^3} = 48{,}920 \text{ kg.}$$

This corresponds to blocks 4 m. by 3 m. by 2 m.

The thickness of the cover will be 4 m. The level of the berm 2h = 8 metres below low water spring tides.

The upper level of the cover is $\frac{3}{2}$ h = 6 metres above high water spring tides.

The level of the parapet coping is $\frac{5}{2}$ h = 10 metres.

The beam is designed with a width of 5 metres.

The protective covers m and n are 3 metres thick.

Fig. 2 is the cross-section of a breakwater exposed to waves with 4 metres amplitude.

Taking 2:1 as the slope of the principal cover, the weight of the rubble will be

$$P = \frac{15 \times 4^3 \times 2.6}{\left[\frac{2}{\sqrt{5}} - \frac{1}{\sqrt{5}}\right]^3 [2.6 - 1]^3} = 6.812 \text{ kg.}$$

That is to say that the pieces of rubble ought to have a weight in excess of 7 tons and consist of three layers, the principal cover will have a thickness of about 4 metres.

The level of the berm is 2h = 4 metres below low water.

The level of the cover crest = $\frac{3}{2}$ h = 3 metres above high water.

The level of the parapet coping is $\frac{5}{2}$ h = 5 metres above H.W.

Width of the berm: 3 metres.

Thickness of the secondary cover: 2 metres.

In conclusion, we will say that, in general, all the mound breakwaters have withstood severe storms with the profile as first designed or with modifications in the slope originally proposed, modifications which have been introduced during the passage of time, when extraordinary tempests have shown the slope or weight of the blocks to be insufficient; that is to say, that mistakes made in this class of breakwater, if they have had expensive consequences, have not been irremediable.

Notes of the Month

Proposed Oil Storage Base at Vancouver.

A project is on foot for the construction of a large oil storage base at the port of Vancouver, British Columbia, to serve the Orient trade and the British Columbia fishery industry.

Resignation of Dock Commissioner.

It is announced that on grounds of ill-health, Mr. William A. Whitelaw has resigned his membership of the Leith Dock Commission, which he has held since 1924. He was convener of the Works Committee for a period of 15 years.

Seattle Port Election.

At the annual meeting of the Port of Seattle Commissioners, Washington, U.S.A., Mr. John A. Early was elected President, in succession to Mr. Horace P. Chapman, who was elected Secretary. Mr. E. H. Savage was elected Vice-President. The General Manager is Mr. W. C. Bickford.

Presentation to Dry Dock Engineering Foreman.

Mr. J. W. Chipchase, head foreman engineer of the Middle Docks and Engineering Company, Ltd., South Shields, has been the recipient of a silver salver and a wallet of notes from the management and workmen of the establishment in recognition of his having been created M.B.E. in the New Year Honours List.

Appointment of Port Warden at Montreal.

Captain Robert Henry Monks has been appointed to the office of Port Warden of the Harbour of Montreal, in succession to Captain Robert Campbell Brown, who retired on May 1st after 20 years' service. Captain Monks, a native of Manchester, has been deputy Port Warden since 1925.

Rectification of Mouth of Capilano River.

Dredging operations are about to be undertaken by the Canadian Government at the mouth of the Capilano River, British Columbia, for the purpose of diverting the outlet to the westward. The object in view is to conserve the navigable channel, which at present is threatened by the blockage due to detritus brought down the river in seasonal freshets.

Proposed Mid-Scotland Ship Canal.

The project of a Mid-Scotland ship canal suggested by Sir John Graham Kerr as a post-war reconstruction scheme has been discussed at a recent meeting of the Scottish Unionist M.P.'s. With Sir John as chairman, a committee was appointed to consider the proposal and report upon it to the group. The committee consists of Major Lloyd, Mr. Watt, Major McCallum and Commander Galbraith.

New Slipway at Fremantle.

A new slipway has been completed on the south side of Fremantle Harbour, Western Australia, and will be known as the South Slipway. Owned by the Public Works Department of the Western Australia Government, the new slipway has an extreme length of 944-ft., and a length of cradle up to 300-ft. maximum. The draught on keel blocks at H.W.O.S.T. is 13-ft. 9-in. forward and 28-ft. 9-in. aft. The lifting power is 2,000 tons. The difference between H.W.O.S.T. and ordinary neap tide is 1-ft.

The Institute of Transport.

The following have been elected by the Council of the Institute of Transport to hold office for the year commencing October 1st next:—President: Sir William Wood. Vice-Presidents: H. M. Cleminson, L. W. Gupwell, C. M. Hoffe, R. H. Jones, O.B.E., G. Mills, J. H. Stirk. Hon. Treasurer: C. J. Selway, C.V.O., C.B.E., T.D. Hon. Librarian: R. Bell, C.B.E. Hon. Solicitors: Joynson-Hicks and Co. Past Presidents to serve on the Council: Sir Alexander Gibb, G.B.E., C.B., F.R.S., Sir Cyril Hurcomb, K.C.B., K.B.E., J. S. Nicholl, C.B.E., Sir Alfred Read, G. S. Szlumper, C.B.E., T.D., T. E. Thomas, C.B.E.

Dartmouth Harbour Commissioners.

By an Order in Council (S.R. and O., 1943, No. 581), the term of office of the Dartmouth Harbour Commissioners has been extended for a period of three years, i.e., to 1946.

Southampton Harbour Board.

At the annual meeting of the Southampton Harbour Board on April 30th, Mr. Harry Parsons was elected chairman of the Board for the 21st time. Sir Sidney Kimber was re-elected deputy-chairman.

Silting of Eyemouth Harbour.

In response to representations concerning silting in Eyemouth Harbour, Berwickshire, the Secretary of State for Scotland has intimated that a new entrance approach to the harbour cannot be considered because of the cost. In an endeavour to allay the trouble the Eyemouth Harbour Trust propose to construct a groyne from the inner pierhead.

Mombasa Port Extension.

It is announced that the first of two new deep-water berths at the port of Mombasa, Kenya, which have been under construction, will be completed in the course of the current month and will be followed very shortly by the second berth. The total cost of the new berth is estimated at £410,300; it is being borne by the Kenya and Uganda Railways and Harbours Administration.

Hull and Goole Port Labour Board.

The following changes in the membership of the Hull and Goole Port Labour Board are reported. The new chairman is Mr. J. H. Howarth and other new members are Messrs. W. P. Allen, W. V. M. Copeland and S. A. Cullington, who take the places of Messrs. W. Fenton, W. Minnitt Good, D. E. Fleming and D. Murray, resigned or retired.

Inverness Harbour Development.

An ambitious scheme for providing facilities for Atlantic liners at the port of Inverness has recently been under consideration by the Inverness Harbour Trust in connection with a plan presented by Mr. Alexander Grant, Engineer to the Trust. It was stated that a scheme of this magniture, for the berthing of deep draft shipping, is contingent upon the receipt of a substantial grant from the Treasury and Provost Mackenzie, with the consent of the Trust, undertook to make enquiries as to the attitude of the Government on the matter.

Pilferage at Birkenhead Docks.

Three men were sentenced at Birkenhead Police Court on May 5th, to imprisonment with hard labour for thefts of tea from the hold of a ship which had been taken, after unloading at another dock, to a ship-repairing yard. A case had been broached and the tea in the hold was the remains. The presiding magistrate made the following observation: " We are not at all satisfied with the conduct of the shipowners in leaving this tea in the hold after the cargo had been discharged. It seems that very grave negligence has been shown."

Proposed River Bridge at Southampton.

The Southampton Harbour Board have had under consideration plans for the construction of a new bridge over the River Itchen submitted by the Town Planning and Development Committee of the Borough Council. The design shows the suggested level of the bridge as giving a headroom of approximately 50-ft. at high water. The Works and Harbour Committee recommended the Board that a fixed bridge at the specified site should have a clearance at high water of ordinary spring tides of not less than 100-ft. Alternatively, if a swing bridge be constructed the opening span of the bridge, through which vessels could pass, should be not less than 120-ft. wide and the clearance at high water ordinary spring tides not less than 50-ft. The Board approved the Committee's recommendation.

The Port of Southampton in 1845.

"A Mail Packet Town" *

A Picture of the Port of Southampton nearly Ninety Years Ago

All the world knows that Southampton, situated about midway in the British *(sic)* Channel, offers a convenient and safe harbour for vessels of all kinds. All the world ought to know it, for the fact is a very old one; it was common knowledge in the reign of Ethelwolf, almost a thousand years ago. Southampton even then was an old and thriving town—good proof of its prosperity being supplied by the fact that it was thought worth robbing by the Danes.

Within the last fourteen years, Southampton has become a town, and this, too, all the world very well knows, of first rate importance to this country. The South-Western Railway, providing between London and Southampton rapid and easy means of transit, so connects the towns that the Southampton of the present day has become a channel outport of London, for the outward and homeward-bound passengers and mails along the principal ocean-routes of the world.

There are eight steam-packet companies connected with the port. They own nearly a hundred steamers, the original cost of which was above six millions sterling. The neighbourhood of Southampton docks is now crowded with eating houses, restaurants, Oriental, American, Dock, Temperance and Railway hotels, hotels Français and Spanish fondas. Amongst the seamen of the East and West India and American steamers, are great numbers of negroes, lascars, creoles, Arabs, mulattoes and quadroons. When a couple of large mail steamers arrive on the same day, as often happens, the windows of the hotels are to be seen crowded with foreign merchants, West India and American planters, East Indian, Australian, and Californian nabobs, military or naval officers, and foreign officials, with their families, dressed in every variety of costume. All these people are at the same time besieged vigorously in all their hotels by English, Italian and German street bands. A great many street musicians get their bread by playing before the Southampton hotels on packet days. Of German bands there are a dozen located in the town. They are imported, drilled, paid wages, and furnished with instruments by a resident German, who is often to be seen at a short distance from the performers, paying critical attention to their music, and perhaps having an eye on their receipts. This man groups the performers. Sometimes you may see a band of twelve with music stands and books, playing choice and difficult music before one hotel. At other times such a band is not to be found in the town; its members are booked up into several parties who are playing before several hotels Polkas, Vilikinses and Last Roses of Summer. The band arrangements all depend upon the concentration or dispersion of the passengers, and upon the rank, taste, and wealth of the arrivals.

The scenes incident to the incoming and outgoing of packets are of all kinds. All dread of observation is apt to be laid aside when parents are taking leave for years of children, or wives part from husbands bound for a port thousands of miles away. It is the same when for the first time after a long absence. When a homeward packet enters the Southampton dock, there is a rush through the dock gates of friends of the passengers. They have been waiting for the ship perhaps for days. It is half-an-hour before the huge bulk of the steamer can be hauled alongside the quay. During this time the passengers are grouped on deck, intently looking for their friends on shore; the friends ashore are not less intently searching among the passengers with opera glasses. Presently there are recognitions, and a kind of sacred pantomime begins. The friends on the quay seem to be suffering the pains of Tantalus. They walk hurriedly to and fro smiling to themselves; then they stop short, stand still, and gaze intently on the vessel; then they kiss a hand or wave a handkerchief, and restlessly walk up and down again. The minutes spent in bringing the ship fairly alongside seem to them hours. At the first moment possible they make a rush to get on board, but are kept back by the Custom House officers, with a bluff order that " they must wait ashore until the passengers have landed."

* * * *

Sometimes the large steam-packets leave the docks, and go out into what is called the stream, a day or two before they depart on their voyages. When that is the case, small steamers run to and from them and the dock quay, carrying their mails and passengers. You may always tell the line to which such an outward-going

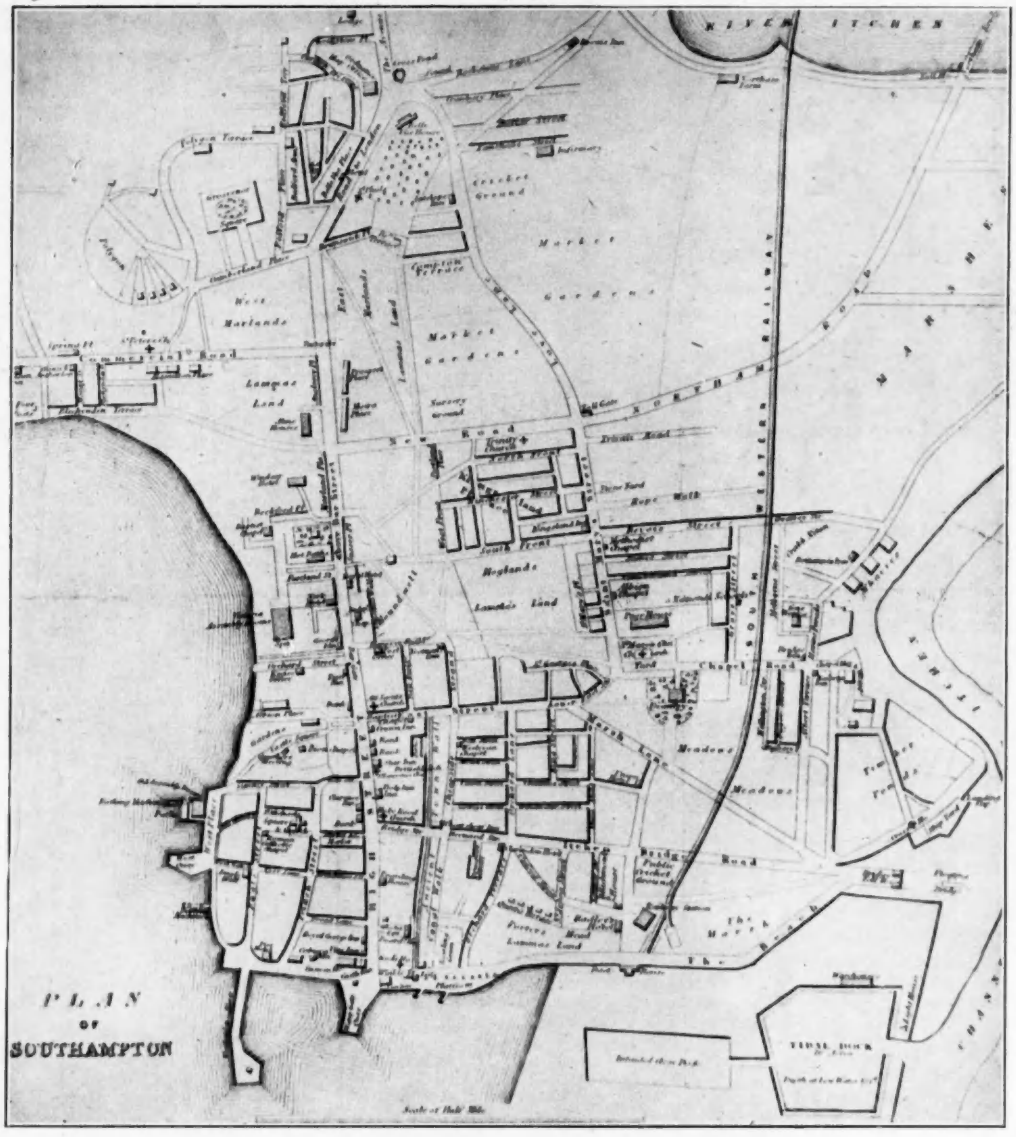
*Reproduced in abridged form from an article with above title, in quotation marks, in *Household Words* a weekly journal " conducted " by the celebrated novelist, **Charles Dickens.** The date of the issue is January 6th, 1855.

"A Mail Packet Town"—continued

packet may belong by the appearance of the passengers. If you see about the dock, bearded, moustached, jim-crow-hatted gentlemen, who smoke much, the American packet is about to start. If you see a number of thin, pallid, bilious-looking persons, with white chip hats, and accompanied by cadaverous-faced ladies, and coloured women, carriers of babies that are neither white nor black, the West India steamer is about to get under weigh. If you observe a number of well-dressed, clean-shaved, healthy-looking fellows, with heaps of luggage, leisurely going into the docks in cabs, some turbans and fezzes, now and then appearing, it is the East India packet that is getting up her steam. Even the appearance of the mails will show to what part of the world the ship is bound. Huge India-rubber sacks contain the American mails; canvas bags the West Indian letters; and the East India mail is contained in variously coloured boxes.

* * * *

Two flags flying at the pier-head denote an ocean steamer in sight and making its way up the Southampton waters. The news spreads through as much of the neighbourhood as feels any interest in the matter. Bay windows are flung up, telescopes protruded, and many are the guesses as to whether it is the *Magdalena* or the *Croesus*—whether it brings dollars or nuggets. Many a bet is laid, and many an anxious knot of people hastens to the docks to have the question settled. A Jersey packet, laden with troops for the army of the East, is at the moment being hauled alongside the wharf, the military band playing, The Girl I Left Behind Me. But, for once, soldiers and deserted damsels pass unheeded; the war in the East is forgotten in the interest excited by the steamer from the West.



Plan of Southampton, 1845, showing the first tidal docks.

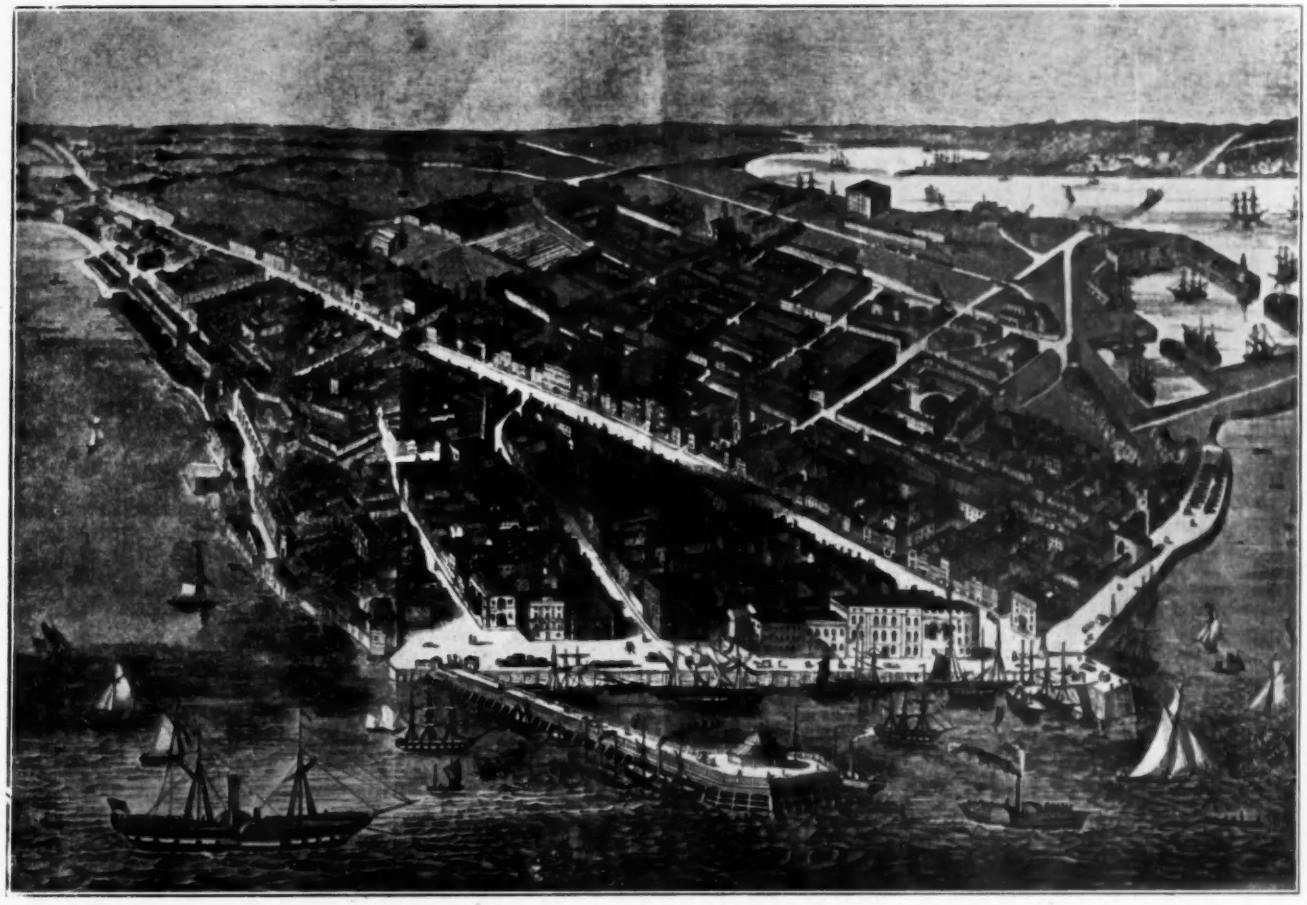
Far out upon the waters a puff of smoke and a black hull of a ship are perceptible, and we are told the ship is the *Magdalena* from the West Indies and the Pacific. On an incredible short space of time the gigantic *Magdalena* has swept up to the dock-heads, and is making her stately entrance within the pool. She floats past the spot where Canute is said to have once seated himself; and, sending forth volumes of steam and gigantic puffs and groans about the paddle-wheels, enters the docks. A score or two of shore-men halloa to a score or two of sailors; and, after a good deal of hard swearing, coaxing, and struggling, they have lassoed the ocean monster by the means of hempen ropes, then they pass heavier cables round the capstans and the ship is made a prisoner.

"A Mail Packet Town"—continued

I have come down to the dock with the expectation perhaps of getting on board and witnessing a scene of the wildest confusion and disorder. I find nothing of the kind. I step on the *Magdalena's* clean white deck, and may suppose, if I like, that I am on board the vessel outward bound, ready cleaned for her voyage to St. Thomas's. But, looking towards the saloon, I perceive groups of sun-burnt passengers lounging as only Indian residents know how to lounge on couches and settees. Few of them appear to be at all anxious about landing, and the ladies, at any rate, seem to be more intent on their shawls and fans than on the prospect of British ground so near them. Among the more languid groups are some huge bearded men who may have been spending a dozen years amongst the Mexican wars, or at the Californian gold-fields, or in the Peruvian silver mines, they look so savage and so reckless of appearance. Meanwhile the necessary work is being done quickly, though quietly, on deck. Fifteen minutes after the mooring of the vessel, there remains scarcely one of her crew and officers on board. The fires are out, and the engine-room looks as snug and empty as though there had been no work done in it for a week. The steward's department is in perfect order, every plate and decanter in its place, and left in charge of a cuddy servant. Not a loose rope lies about the deck, which, forwards, is as clean and still as a churchyard. Here and there a sailor or stoker may be seen in clean attire shouldering a bundle of pineapples or a few cocoanuts, and making quietly for shore. The passengers have glided on shore with little bustle, in most cases, and those who have been met by friends are stirred out of their listlessness. I take another stroll up the saloon—there is still a deputy stewardess with a cuddy servant or two hanging about the tables and the lamps.

* * * *

Two more flags run up the mast on the pier, indicating the approach of another of the large sea-going steamers. This time it is a vessel belonging to the General Screw Steam Shipping Company—the *Croesus*—a noble steamship on the auxiliary screw principle, and bound from the Australian colonies. No sooner had she been caught in the huge rope nooses flung over her sides, quarters and bows, and coaxed alongside the quay, than I am on board. Here, also, all is fresh, clean and orderly; but in no time there is also bustle and activity enough. Nobody had two seconds to spare. How different the aspect of the saloon! Shaggy-headed, long-bearded fellows, with hands hardened by use of pan, cradle and pick, look as frank, and free, and honest as the weather-beaten, but more reasonably-clad and smoothly-shorn Australian farmers near them. Many are the questions asked of the shore folk about the war, and about the price of wool. Many an anxious gladdened look is cast on the town and the townspeople crowding to the dock to welcome the Australian diggers. Energetic are their recognitions of their friends, sturdy the hand-shakings, hearty the kisses.



General view of Southampton, taken from the "Illustrated London News," 1844.

The next steamer in is a paddle-ship, from the Brazils. The most interesting group on board this ship is a party of liberated Africans—slaves freed by the instrumentality of our cruizers, who have come to this country for information and enlightenment. As black as midnight, with brilliant skins, white teeth, and curly hair, this dusky part is grouped near the paddle-boxes, full of curiosity. Accustomed to see only blacks engaged in labour, they are not a little amazed to see so many white men shouldering huge boxes, trunks, and portmanteaus, and running with them over the ship's side to the quay. At length their own time for moving arrives, and catching up their small bundles of worldly goods they

"A Mail Packet Town"—continued

follow their guide to the shore, and thence to the railway station, as mechanically as though moved by the action of a spell.

The day is so far spent when the next steamer is signalled that she has to be brought up at the buoy on the river, where she lies all night. This vessel—the *Ripon*—brings an Indian prince and an Egyptian hippopotamus. I therefore accept the offer of the superintendent of the Peninsular and Oriental Company, who is on the point of going on board, and take a seat in his boat. As we approach the steamer the distant glimmer of the many flickering lights takes a brighter and distincter shape. Dark forms can be seen passing before the lights. A strain of wild music breaks upon our ears as we ascend the ship's side and tread her deck. It comes from below, and is mingled with the sound of strange voices singing in some unknown tongue an Oriental chant. For in the saloon is assembled listening to the strange Oriental music and eastern ditty of some of the Rajah's people—he himself sitting apart on half-a-dozen feather beds, and screened off from the herd with fifty yards of silken curtain. Bengal indigo planters, Bombay merchants, Madras civilians, and military officers from the north-west provinces, are reclining in all sorts of attitudes, while the little Hindoo band sends forth its wild air from a lute and an instrument partly guitar and partly jew's harp.

SUPPLEMENTARY OBSERVATIONS.

BY THE EDITOR.

In order fully to appreciate the foregoing description of the activities of the Port of Southampton it is necessary to have some precise particulars of port accommodation at the epoch in question. At that time the excellent deep-water quayage with which the port is now equipped did not exist and the berthage accommodation for shipping was almost rudimentary and certainly relatively insignificant. There were only two small wet docks: one a tidal basin, completed in 1842 at a cost of £140,000, with an area of 16 acres and a depth of 18-ft. at low water; the other, an inner enclosed dock, completed as recently as 1851, with an area of 10 acres and a depth of 28-ft. It was not until a much later period that the well-known Empress Dock was constructed and later still, in the early years of the present century that the fine Ocean Dock became available for shipping. The construction of the magnificent River Test Quay is, of course, an event of quite recent date.

The former London and South-Western Railway, now merged in the Southern Railway acquired the early docks undertaking from the old Southampton Dock Company in November, 1892. This step was followed by the opening of the Prince of Wales Graving Dock, at that time the largest of its kind in existence. Ten years later, the Trafalgar Graving Dock came into commission.

The provision of these serviceable facilities led to the transfer in 1907 of the White Star Line's North Atlantic Express service from Liverpool to Southampton, and twelve years later a similar step was taken by the Cunard Line and the Canadian Pacific Line.

The remark about a Jersey packet laden with troops for the Army of the East is clearly an allusion to the Crimean War, which broke out in the Spring of 1854, when this country joined partnership with France in the defence of Turkey against Russia. A few months before the article appeared in *Household Words*, the Allies had gained the victory of the River Alma (September 20th, 1854); the brilliant charge of British Cavalry had taken place at Balaclava (October 25th, 1854), and the Battle of Inkerman had been fought (November 5th, 1854). One can but contrast the calm, unhurried, almost indifferent attitude of the port in the face of important military operations with the pressure on shipping and the rigorous restriction of civilian movements in the present struggle. "Total" war was a thing undreamt of in those days.

The references to individual ships are of particular interest and port officials will be struck by the pretentious epithets applied to vessels of very moderate proportions judged by present-day standards. Efforts have been made to ascertain the size and tonnage of the "gigantic" *Magdalena*, the "noble" *Croesus* and the *Ripon*. The following particulars have been obtained through the courtesy of Lloyd's Register of Shipping, which, unfortunately, is unable to supply linear dimensions. All the vessels named had London inscribed as their port of registry:

Name of Vessel	Tonnage	Horse-Power
Magdalena	1,800 net	800
Croesus	2,500 gross	400
Ripon	1,308 net	460

The *Croesus* was built by Mare, of Blackwall. The General Screw Steam Shipping Company is stated to have received the first Government contract for conveying mails to the Cape of Good Hope by steamship.

With a view to obtaining further information, application was made to the Registrar-General of Shipping and Seamen, but his Department has been unable to furnish dimensions or any additional particulars. Perhaps our readers may be able to throw light on those early steamship designs.

The illustrations accompanying the foregoing extracts from *Household Words* have been kindly supplied by the Southern Railway Co. They are extremely interesting and though of a date a few years anterior to the year of publication of the article, they afford an excellent idea of the condition of affairs at the port at the time. The plan shows the position of the two wet docks, one already constructed and the other projected.

Port of Parà: Alteration of Name.

An official announcement has been made that the name of the Brazilian port of Parà has been changed to Belem. As there is already a town of this name in the South of Brazil, it is difficult to see how some amount of confusion between the two places is to be avoided.

Facilities for Aircraft in West of Scotland.

Mr. William Cuthbert, Chairman of the Clyde Navigation Trust presided on April 30th at a Sub-Committee of the Trust appointed to deal with the question of Facilities for Aircraft, which met for a second time representatives of several West of Scotland Local and other Authorities. The Chairman referred to the resolution at the joint meeting on 25th March that there should be an International Airport in Scotland and to further enquiry by the Sub-Committee and the Trustees. He said he was anxious to reach, if possible, general agreement as to the situation of the International Air Port and he put to the meeting a motion that the Scottish International Air Port should be situated in the West of Scotland at a site named, that its ownership should be vested in the Government or a Statutory Body and that representations be made to the Secretary of State for Scotland accordingly. The motion was seconded by Sir Patrick J. Dollan, and had unanimous approval. The finding of the meeting accords with the recommendation of the Scottish Council on Industry.

Port of Sunderland Health Authority.

The result of an interesting investigation into the cause of a skin affection experienced by dock workers at the Port of Sunderland, is recorded in the annual report of Dr. A. S. Hebblethwaite, the medical officer of health at the port. A cargo of grain which had been stored in a warehouse for more than two years had to be moved for milling purposes. Dock labourers engaged on the job complained of a skin disease on the face, neck and hands, which they thought was due to living organisms infecting the grain. The men demanded an enquiry. About this time the Medical Officer had been making an investigation into an infection of self-raising flour and proprietary articles made from such flour, which were heavily infected with *tyroglyphus farinae*. This organism caused the whole mass to appear to be alive. Examination of the grain at the warehouse showed no living organism present, but owing to the length of time which the grain had been stored in a dry condition the outer husk had become separated, split up, and in many instances this had left very sharp points in its construction. It was these sharp angles which had caused irritation to the dockers' skin. This disability is now avoided by covering the skin with grease. A noteworthy feature of the investigation was the complete satisfaction of the men's representatives when they saw by the aid of a miscroscope that the grain contained no living organism.

Ship Caissons for Dock Entrances

An Article for Students and Junior Engineers

By STANLEY C. BAILEY, Assoc.M.Inst.C.E., F.G.S.

(Concluded from page 22)

Centres of Gravity and Buoyancy

The centre of gravity is found by calculating the weight of each item, and multiplying by its distance from the keel, the sum of the moments thus obtained, divided by the total weight, will give the height of the C.G. above the keel. The height of the centre of buoyancy is the valume of each immersed item in cubic feet, multiplied by its leverage from the keel, and divided by the total volume, or each item may be reduced to tons by dividing by 35, for sea water at 64 lbs. per cub. ft.

The total weight of the caisson cannot be accurately found by calculation until it is launched and the draught obtained.

When the preliminary design has been prepared, approximate calculations may be made of the weight and buoyancy by grouping portions together, such a beams, frames, decks, side plating and tanks, etc., and taking the mean C.G. of each group, for the leverage from the keel, the C.B. being found in a similar manner. When the figures are obtained it may be necessary to alter the positions of the decks of the air chamber to ensure satisfactory results, it is a question of trial and error.

The water displaced by the immersed steelwork in the upper tidal chamber will amount to about 0.013 cub. ft. per cubic foot of caisson under water, and about 0.04 cub. ft. in the lower tidal chamber

Stability of Caisson

Ship caissons when floating freely and without ballast may be fairly stable with the C.G. above the C.B., but may not float vertically, and will be very lively, and oscillate violently in a wind.

In conical buoys the C.G. is invariably above the C.B. and when free of the mooring cable, will not float vertically, unless about half of their weight consists of water ballast, so it is important in the case of caissons that the C.G. should be close to, and preferably below the C.B. because when they are careened at an angle of say 30 degrees to the vertical, the metacentre (M.C.) may fall below the C.G., in which case they will overturn. For stability purposes, the metacentre should be above the centre of gravity. The metacentre is obtained by drawing a vertical line through the C.B. of the inclined caisson, and where this line cuts the inclined axis of the caisson drawn through the C.G. the intersection will be the M.C. as shown in Fig 7. The vertical distance between the C.G. and M.C. is the metacentric height and should be about 2-ft., the higher it is, the more lively will the caisson be. The distance M.C. to C.B. is the metacentre radius, and the pendulum is the vertical distance between the C.B. and C.G. this should not be less than 13-in., preferably the C.G. should be about 2-ft below the C.B.

The wind pressure required to careen the caisson shown in Fig. 7 to an angle of 30 degrees, will be as follows, viz.: the weight of the caisson is about 873 tons + 175 tons of concrete, and 35 tons of water ballast, a total of 1,083 tons to float it with 1-ft. freeboard to the top of the air chamber, or 9.17 tons per lin. ft. on 118-ft. average length. The moment of the caisson is = W.x. where x is the horizontal distance between the C.B. and C.G., therefore 9.17 by 1.3-ft. = 11.92-ft. tons per lin. ft. The moment of the wind = P.h. where h = 10.5-ft., therefore the wind pressure (P) to balance the moment of the caisson = $\frac{11.92}{10.5}$ = 1.13 tons per lin. ft. = 1,531.2 lbs. and $\frac{1,531.2}{21 \times 1}$ = 72.9 lbs. per sq. ft. This is a tornado pressure, but a lower intermittent pressure would cause the caisson to oscillate so much that an angle of 30 degrees may easily be reached.

Fig. 8 shows the positions of the centres of buoyancy and the metacentre when the caisson is careened at different angles; so that when the vertical lines normal to the water level are drawn through B1, M1 and B2, M2, etc., they will intersect at points P1, P2, etc. these points are known as prometacentres and M1, M2, etc., as shifting metacentres, while P1, B1 and P2, B2, etc., are the radii of the curve of buoyancies for the different inclinations.

Fig. 9 is the outline of a typical caisson having the same sectional area as the caisson in Fig. 7, and an air chamber of equal volume, it is designed to lower the centre of gravity so much as possible. The decks of the air chamber are placed clear of the corner angles to enable the riveting of the latter to be more easily carried out, and curved plates which are expensive, and common to so many caissons, are avoided.

Calculations for Buoyancy and Ballast

Assuming that the caisson shown in Figs. 1, 2 and 3 is required to be floated out with 1-ft. freeboard from the water level to the top of the air chamber, the weight of the caisson exclusive of ballast being 873 tons, then the following approximate calculations may be made for buoyancy, viz.:—

	cub. ft.	tons
Air chamber 12-ft. high to W.L. displaces ...	34920	
Stems, keel, and walings displace	898	
Steelwork in lower tidal chamber, 21,584 cub. ft. × 0.04 = ...	863	
Buoyancy =	36,681	= 1048
Less the weight of the caisson =		= 873
Ballast required =		175

As this ballast may be put in the bottom as burr steel concrete weighing 320 lbs. per cub. ft., or 7 cub. ft. per ton, therefore 175 × 7 = 1225 cub. ft. of ballast will be necessary, which will increase the buoyancy by that amount. Therefore the total buoyancy will be 37,906 cub. ft. = 1,083 tons, and the weight of the caisson will be 873 + 175 = 1,048 tons, the difference of 35 tons will be the water ballast required in the end tanks of the air chamber.

In order to sink the caisson at H.W.O.S.T. in its groove or stop at the entrance, additional water ballast will be necessary in the scuttling tanks, and the buoyancy will be as follows, viz.:—

	cub. ft.	tons
Air chamber 13-ft. high displaces	37830	
Stems, keel, walings and fenders displace ...	1471	
1½-in. asphalt on top deck of air chamber ...	350	
Steelwork in upper chamber, 28050 cub. ft. × 0.013 = ...	364	
Steelwork in lower chamber, 21,584 × 0.04 =	863	
Concrete ballast =	1225	
Buoyancy =	42103	= 1202
Less weight of caisson		= 1083
Extra ballast required		= 119

In the above calculations decimal places have been omitted from the figures. To avoid pumping water out when floating the caisson 100 tons may be placed in the scuttling tanks, and 19 in the trimming tanks in which an additional 5 tons will be required to provide a margin of safety against uplifting should the tide rise higher than H.W.O.S.T. so that the pressure on the keel will only amount to 5 tons, but at L.W.O.S.T. the pressure will amount to

Ship Caissons for Dock Entrances—continued

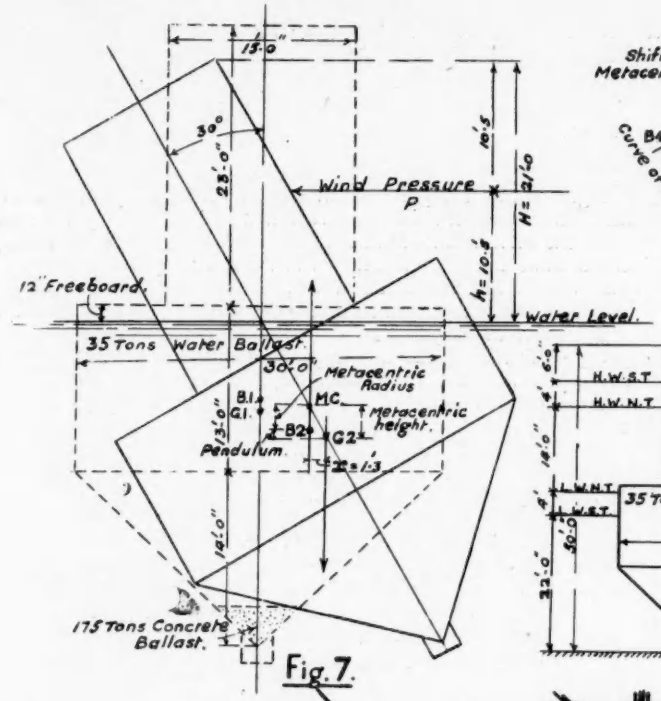


Fig. 7.

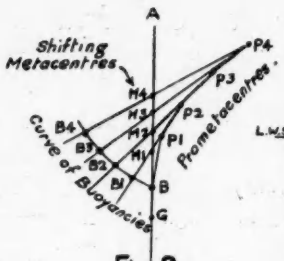


Fig. 8.

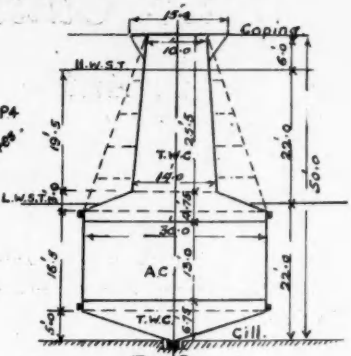


Fig. 9.

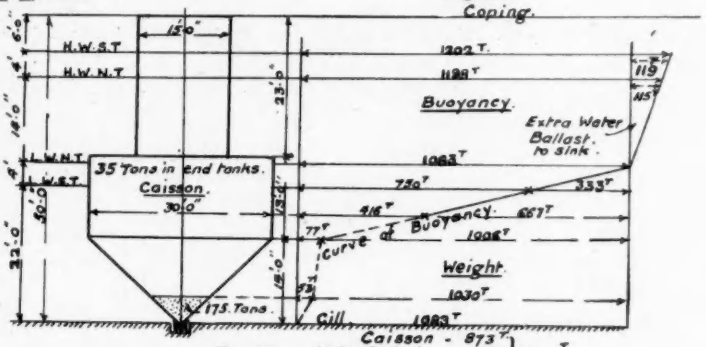


Fig. 10.

Caisson - 873 T.
Water Ballast - 35
Concrete Ballast - 175
} 1083 T.

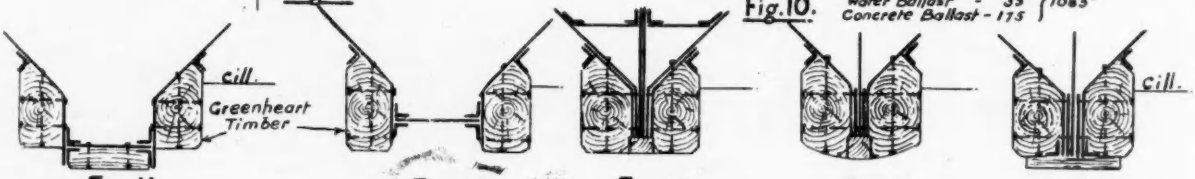


Fig. 11. Fig. 12. Fig. 13. Fig. 14. Fig. 15.

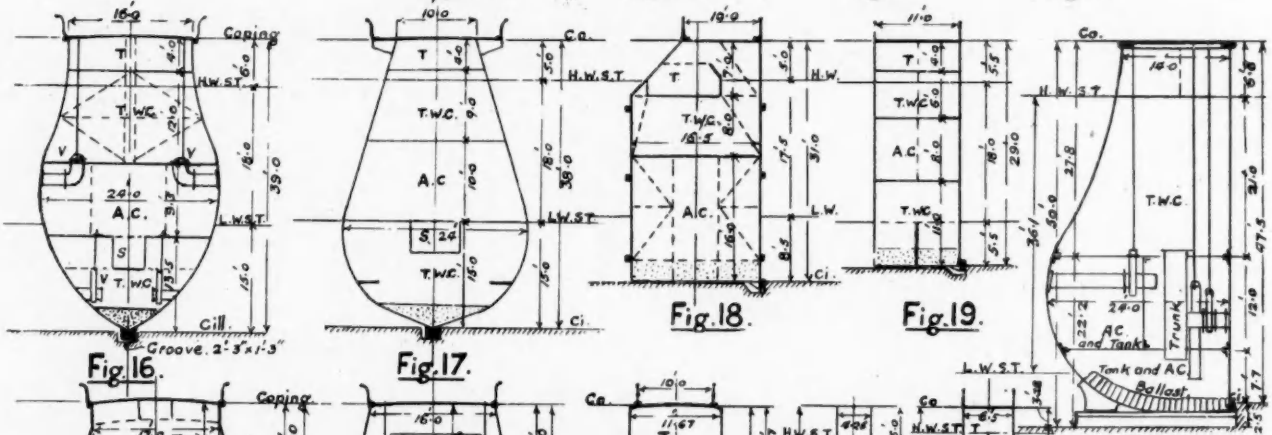


Fig. 16. Fig. 17. Fig. 18. Fig. 19. Fig. 20.

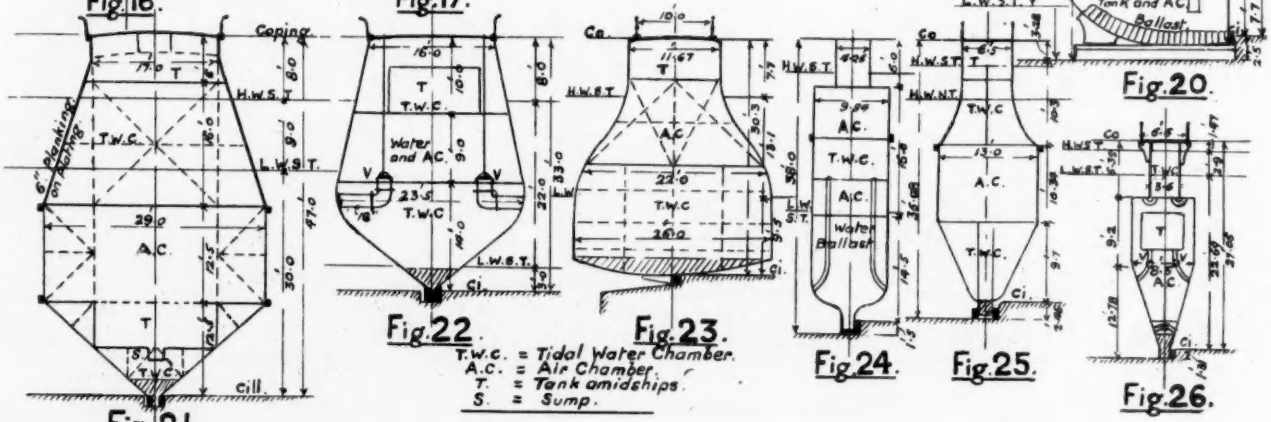


Fig. 21. Fig. 22. Fig. 23. Fig. 24. Fig. 25. Fig. 26.

T.W.C. = Tidal Water Chamber.
A.C. = Air Chamber.
T. = Tank amidships.
S. = Sump.

Ship Caissons for Dock Entrances—continued

333 + 119 + 5 = 457 tons as shown in the buoyancy diagram Fig. 10 and $\frac{457}{110}$ = 4.1 tons per lin. ft.

Similar calculations are made for each water level and the approximate curve of buoyancy shown in Fig. 10 is thus obtained.

When a caisson has been in use for some years there will be a slight increase of weight due to accumulations of mud in the tidal water chambers, in which case some of the water ballast can be reduced.

In Figs. 11 to 15, cross sections are shown of the keels of various caissons, the edges of the plates being protected with timber.

Diversity of Types of Caissons

There is a considerable diversity of types of ship caissons, some of which are shown in the outline cross sections Figs. 16 to 26, all drawn to the same scale; the chief points to be observed are that as the water pressure is small at the top deck, the width can be reduced, and the sides battered outwards or built vertically down to the air chamber, where the greatest width is given, because of the increased pressure, and to obtain sufficient buoyancy. The difference between the width at the air chamber and that at the top is known as " tumble home."

The older forms of ship caissons have cross sections similar to those of old type sailing vessels as shown in Figs. 16 and 17, a few are rectangular (Figs. 18 and 19), but these are constructed for the purpose of lengthening existing old dry docks several feet, to avoid lengthening the dock. The caisson shown in Fig. 20 was designed to fit a number of dock entrances of various widths and depths, and also to enable it to be berthed in the recess formed in the outer entrance of a dock, and lie flush with the entrance walls, this type requires special ballasting to enable it to float upright.

Figs. 24, 25 and 26 are French forms of ship caissons.

Notable Port Personalities

XXXV—Sir Frank Nicholson, C.B.E., J.P.

Born in Sunderland in 1875, **Sir Frank Nicholson.** Chairman of the River Wear Commissioners, after his education at the Sunderland High School, entered upon a commercial career, and in 1898 joined the firm of C. Vaux and Sons, Ltd., Brewers, as their Accountant, in due course becoming Secretary and, later, Managing Director. On the amalgamation of the Company with other brewers, Sir Frank was elected, and is now, Chairman and Managing Director of Vaux and Associated Breweries, Ltd. He is also Director and a Deputy-Chairman of Ind-Coope & Allsopp, Ltd., and has other brewing interests. He has been five times Chairman of the Brewers' Society of England and Wales, and is now a Vice-President.

He has had a long association with the Sunderland Town Council, which beginning with his election in 1908, includes 24 years' service as Chairman of the Finance Committee from 1911-1935. He has been a County Durham Magistrate since 1918, and Chairman of Chester-le-Street Petty Sessional Division since 1935. He has always been especially interested in employment questions, and when the Sunderland and District Local Employment Committee was first created in 1916, he was appointed its Chairman, and has been continually re-appointed ever since. In the same year, 1916, Local Committees under the Ministry of Pensions were set up, and Sir Frank became the Chairman of the Sunderland and Houghton-le-Spring District Committee, and has continued in that office up to the present time. Another of his special interests is agriculture, and he has for several years been Chairman of the Durham County Agriculture Wages Committee: in addition, he is Chairman of the Durham County War Agricultural Executive Committee and President of Durham County Agricultural Society.

His association with the Sunderland Port and Dock Undertaking began in 1920, when he was appointed one of the two Sunderland Corporation representatives on the Emergency Committee which was set up in that year in connection with the direction of the Commissioners' affairs during the difficult period following the last war. This Emergency Committee ceased to function in 1922. He was appointed a River Wear Commissioner as one of the representatives of the Sunderland Corporation on the 10th January, 1923, which appointment he resigned in 1942 on being appointed a Commissioner to represent the Holders of First Mortgages. In 1935, he was appointed Vice-Chairman of

Sir FRANK NICHOLSON, C.B.E., J.P.

the Commissioners, and in 1937 accepted the Chairmanship. He has rendered valuable services on the General Purposes and Finance Committee, of which Committee he is now Chairman. He is also an ex-officio member of the Traffic, Works, and Corporation Quay and Commerce Committee.

He has travelled widely, over a period of years, in many different parts of the world. He was elected Sheriff of County Durham in 1939-1940, and became Deputy Lieutenant of the County in the year 1940. He was awarded the C.B.E. in 1937, and was knighted early in the present year.

Obituary.

The death took place on May 19th, at the age of 63, of **Mr. Bertram Lawrence Hurst,** M.Inst.C.E., M.I.Mech.E., of the firm of Messrs. Hurst and Pierce, consulting engineers. Mr. Hurst was formerly assistant civil engineer at H.M. Dockyard, Portsmouth.

The death has recently taken place at the age of 72 of **Sir Alfred Baker, D.L., J.P.,** an " appointed member " of the Port of London Authority, representing the London County Council, of which he was a month or two ago elected chairman. He had been a member of the Port Authority since 1931 and had served on a number of standing committees.

The fact that goods made of raw materials in short supply owing to war conditions are advertised in this Journal should not be taken as an indication that they are necessarily available for export

*Earth Pressures and Sheet Piling**

By S. PACKSHAW, B.Sc., M.Inst.C.E.

(Concluded from page 15)

Shear Strength

There are several simple methods of determining the value of ϕ for cohesionless materials—for instance, from the natural slope of a bank; moreover, the angle varies only between comparatively narrow limits. With cohesive materials ϕ may be anything from zero up to about 30°; the cohesion may have any value from nothing up to 1,500 lbs. per sq. ft. or more.

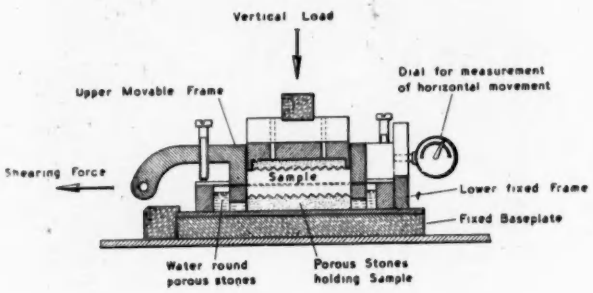


Fig. 6. Shearing Box.

The young science of soil mechanics has provided the engineer with the means of determining these co-efficients and has enabled him to break away from the older theories suitable only for cohesionless soils. The importance of obtaining accurate information on the nature of the ground, so as to enable the new science to be applied, cannot be over-emphasised; this applies particularly to the engineer's client who frequently objects to expenditure on work forming no tangible part of the structure for which he is paying The procedure adopted is to sink boreholes and to use special tools for extracting samples of the soil with the least possible disturbance. As soon as the samples have been brought to the surface they are placed in air-tight tins and sealed with paraffin wax to ensure that there is no change in the water content. In the laboratory various tests are made, some with the sample in its natural state and some after it has been puddled or remoulded. The most important tests are the following:

For Classification: Specific gravity, water content, proportion of voids, mechanical analysis, liquid and plastic limits.
For Design: Shear strength, permeability, compressive strength, consolidation.

For the determination of earth pressures and resistances, the most important tests are the first three in the classification group, as these give the density above and below subsoil water level, and the shear strength in the design group. The latter is usually obtained with the aid of a shearing box as illustrated in Fig. 6. The sample is held between two serrated porous stones and is subjected to a vertical load. When consolidation has ceased the sample is sheared and the stress f_s required to do so is measured. By repeating the process at various vertical stresses f_n a graph approximating to a straight line is obtained as in Fig. 7. The intercept on the f axis gives the value of c whilst the inclination of the line determines ϕ.

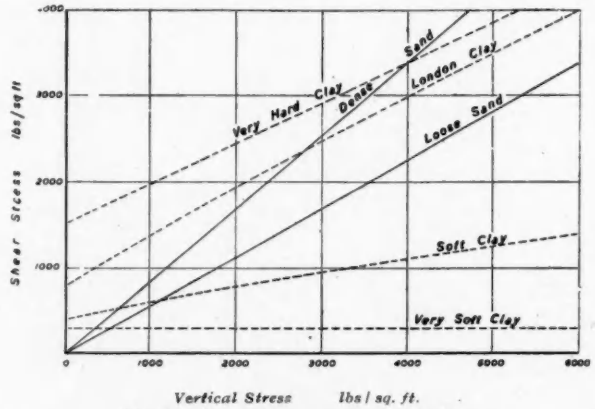


Fig. 7. Shear Stress on Typical Soils.

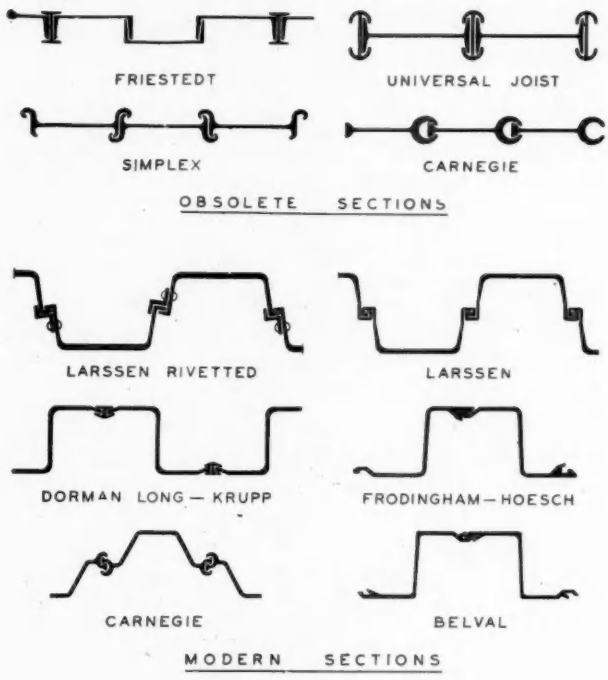


Fig. 8. Sections of Steel Sheet Piling.

The interpretation of the shear tests is not, however, quite so simple as appears at first sight, as it depends on the generally uncertain degree of consolidation reached by the subsoil. In such cases, one has to be satisfied with a knowledge of the total shear strength without separation into its frictional and cohesive constituents.

Types of Sheet Piling

Sheet piling can be of timber, reinforced concrete, or steel. The first two types are adaptations of ordinary bearing piles made from the same materials. They are usually provided with a tongue-and-groove or V joint and as they are already well-known there is little more to be said about them. Steel sheeting presents more variety and consists of rolled steel sections provided with clutches

*Paper read before the Northern Ireland Association of the Institution of Civil Engineers and reproduced by permission.

Author's Note:—The graphs in Fig. 7 are typical of various soils when tested after full consolidation. Immediate shear tests can also be made without allowing the soil time to consolidate. Many soils are not fully consolidated in their natural state and then have a smaller shear strength; in particular ϕ is much less. The examples in Fig. 7 therefore should not be taken as representative even for soils of identical description.

Earth Pressures and Sheet Piling—continued

or interlocks connecting successive piles to one another and thus forming a continuous wall. Some of the many types of steel piling that have been or are being used are shown in Fig. 8. They were developed from early cast-iron or wrought-iron sections used as long ago as the beginning of the 19th century, their purpose

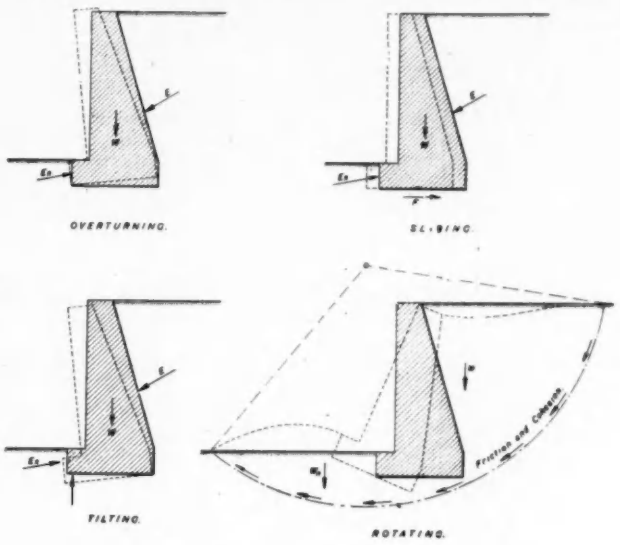


Fig. 9. Failure of Mass Walls.

being to find a material more efficient than timber. The main advantages of steel sheeting over timber are strength, watertightness and an ability to withstand driving and redriving many times.

Modern piling sections endeavour to combine maximum strength with medium weight, and are therefore trough-shaped, being designed on the same principle as other rolled steel sections in which the bulk of the material is concentrated as far away as possible from the neutral axis. The first successful trough section employed riveted interlocks, the necessity for these being imposed by the limitations of the rolling process at that time—namely, the end of last century. Later on, the more efficient dove-tail form was

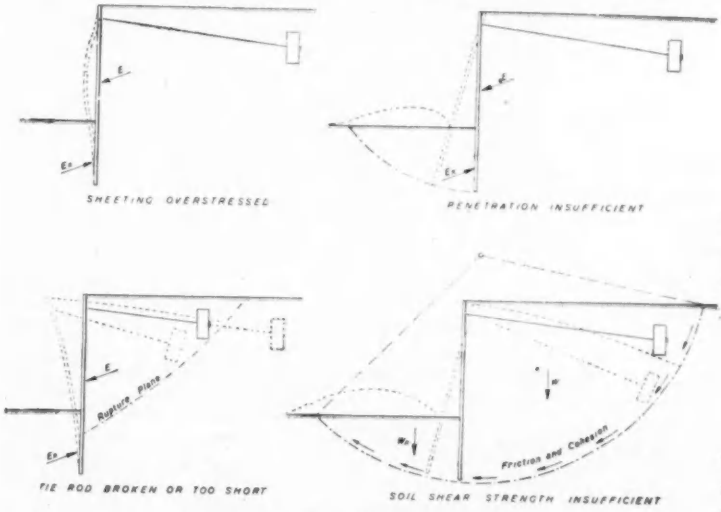


Fig. 10. Failure of Sheet Pile Walls.

adopted. Numerous other types were patented in all parts of the world and a good many of them rolled. Most sections are available in various weights and strengths so as to form a range covering all normal requirements.

Applications of Sheet Piling

A brief description of the various applications of sheet piling can be divided into two categories: temporary and permanent. The former comprises works such as cofferdams, in which the piling is employed merely to permit some other work to be carried out; after completion, it is withdrawn and used again as many times as its condition will permit. Timber and steel are the materials from which temporary sheeting is made. For permanent work, where the piling itself forms the retaining wall, timber, reinforced concrete or steel can be used, generally one of the last two. If the height of the wall is small, the piling can be left as an unsupported cantilever, but as a rule it is more economical to provide one, or perhaps two, tie rods near the top of the wall; these rods are then fixed to a suitable anchorage of sheeting or mass concrete placed far enough behind the wall to be in undisturbed ground. Sometimes anchorages of raking piles are used.

Sheet pile walls have many advantages over other forms of

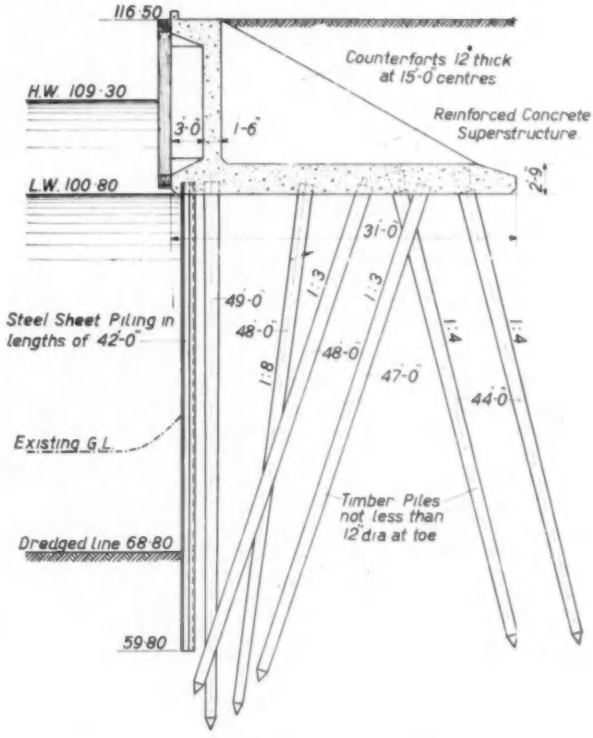


Fig. 11. Quay Wall with Relieving Platform.

retaining walls, particularly in comparison with mass concrete. These are mainly economy, speed of construction and a high factor of safety. Failures of mass walls occur mainly due to the following causes:

Overturning: Pressure greater than calculated.
Sliding: Depth and resistance in front of wall inadequate.
Tilting: Shear strength of subsoil insufficient to withstand the toe pressure.
Rotation: Shear strength of subsoil and backfill insufficient to prevent whole wall and soil rotating and sliding forward.

With sheet pile walls these causes are either absent or easily avoided. The factor of safety in the material provides an adequate margin against over-stressing, whilst the possibility of exceeding the resistance of the subsoil can be eliminated by driving the sheeting to an ample penetration. Moreover, a small increase in penetration results in a considerable improvement of the factor of safety.

The most extensive application of sheet piling for permanent work is in dock and harbour construction. As a rule quays and

Earth Pressures and Sheet Piling—continued

wharf walls are provided with tie rods some distance below the top; a horizontal beam, or waling, takes up the loads from individual piles and transmits them to the tie rods. If the sheeting is of concrete, the waling is naturally of the same material and the ties, as a rule, are also of concrete. With steel sheeting, the waling generally consists of two steel channels. For very high walls, the tie rods become very long and cumbersome and in such circumstances an alternative design can be used: a concrete platform is constructed behind the piling some distance below ground level and is supported on forward and backward raking piles. The horizontal thrust is transmitted to the platform; it combines with the weight of the ground above the platform and is converted into compression in the front rakers and tension or slight compression in the back rakers

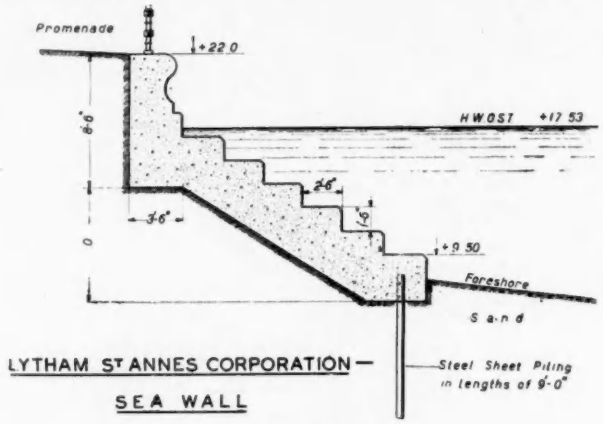


Fig. 12. Sea Wall.

When sheet piling is used for river training works and the protection of river banks, the principles of construction are much the same as in harbour work, though everything is on a reduced scale. The sheeting forms a continuous curtain and is driven to a depth at which it is immune from erosive action, so that the wall cannot be undermined; this is particularly important on rivers liable to rise rapidly when in flood. Similar reasons lead to the use of sheet piling in the design of sea walls; quite a common practice is to build such walls of reinforced concrete in the form of a series of steps rising from the foreshore. At the top of the steps is a heavier wall with a curved front face so that the waves are broken up by the steps and finally deflected back upon themselves by the curved wall at the top. At the seaward end of the steps is a curtain of sheet piling which prevents any seepage of soil from the foundation of the wall and thus ensures the stability of the whole structure. Steel sheeting is use more often than timber or concrete as it can be driven more easily into a sand or shingle subsoil and has a positive interlock preventing leakage.

For land or water cofferdams in the construction of bridge piers, deep building foundations in waterlogged ground and so on, steel sheeting is almost exclusively used though timber is quite suitable for very shallow depths. The old method of driving two lines of timber sheeting with clay filling between them to ensure water-tightness is now very rarely used.

The bracing in cofferdams is nearly always of timber; in large dams, steel is sometimes used. Reinforced concrete has also been employed on a few occasions, mainly in the construction of bridge piers so that the bracing is concreted in the finished structure. The erosion problem mentioned in connection with river training and sea defence walls frequently also arises in bridge construction; in such cases the bottom part of the sheeting can be left in place to protect the foundation of the pier, the upper part being removed by cutting off with an oxy-hydrogen flame under water. Alternatively the piles can be in two part fish-plated together. Another advantage is that the bearing value of the ground under the pier is increased as it is confined within the sheeting.

Steel sheet piling is also used when a new building is to be erected alongside an older one and the new foundations are at a greater depth. Care must then be taken to avoid undermining the existing stanchions by excessive pumping, as the carrying capacity of the subsoil may be reduced when the ground water level is lowered. This is particularly important in fine sand which may be pumped away with the water.

Conclusion

Sheet piling is applied to almost every branch of civil engineering and the engineer concerned with it therefore has a wide range of interests. It is also a satisfying form of construction as it permits the strength of the material to be fully utilised by stressing it up to the normal limits; in most other types of retaining walls only part of the potential strength comes into action. An accurate estimate of the earth pressure, to keep up with the precise knowledge of the properties of the materials, is therefore particularly desirable. Here the new science of soil mechanics is coming to the assistance of the engineer: it enables him to recognise the inevitable fact that the subsoil is an essential part of his structure.

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Publications

Part iv. of the **Report on Reinforced Concrete for Buildings and Structures,** recently issued by the Institution of Structural Engineers (11, Upper Belgrave Street, London, S.W.1. Price: one shilling), deals solely with points in design and construction peculiar to hollow floors. Three types are selected for definition and description, viz. (a) Hollow Tile Floor; (b) Precast Hollow Floor, and (c) Steel Form Floor; and various features of design in regard to these are discussed. The publication consists of 14 pages, including an Appendix and an Index.

Empire Timbers.—The Forest Products Research Laboratory of the Department of Scientific and Industrial Research has published under the editorship of Mr. H. A. Cox, M.A., a *Handbook of Empire Timbers* (War Emergency Supplement) containing additional information on some of the timbers already dealt with and information on sixteen species not previously described. Apart from the botanical details, there are useful practical data on the seasoning and wood-bending properties of each species, together with observations on their liablity to insect attack and natural durability, matters which are of prime importance in structural work. Two appendices contain much useful information, the first consisting of a series of kiln schedules and the second, arranged in tabular form, details of the mechanical and physical properties of the materials in question. A third appendix gives specifications for the teeth of circular saws for ripsawing the timbers. This pamphlet of 42 pages, which has considerable practical value, is published by H.M. Stationery Office at the price of 9d. net.

The Institution of Mechanical Engineers.—Two papers of high value as regard war production was recently read at meetings of the Institution of Mechanical Engineers, viz.: The Hydraulic Operation of Lathes for the Production of Shells, by Mr. W. Littlejohn Philip, O.B.E., and Marking Methods and War Production, by Mr. Arnold Throp. Both papers contain information of the first importance in war work and are illustrated by numerous diagrams and photographs. Other interesting papers, either read or published, were Surface Finish and the Function of Parts by Dr. Georg. Schlesinger, and Quantitative Analysis of Single-and-Multiple Capacity Plants by Mr. Paul G. Kaufman.

*Trawling and the Stocks of Fish**

By E. S. RUSSELL, O.B.E., M.A., D.Sc., P.L.S.,
Director of Fishery Investigations, Ministry of Agriculture and Fisheries.

Introduction

In the year 1937, when the threat of war had not yet begun to affect fishing operations, just over 17 million cwts. of fish were landed by British vessels in the ports of England and Wales. Of this quantity, 13½ million cwts. were what we call, in our official statistics, demersal fish, that is to say fish, such as cod, haddock, hake, plaice and many others, that are caught on or near the bottom of the sea; the remainder were the so-called pelagic fish that are caught near the surface, by far the most important of these being the herring. The methods of fishing and the gear employed to take these two groups of fish are, of course, quite different, the bottom-living fish being captured mainly by the trawl, the surface fish chiefly by drift-nets. The two fisheries are, in fact, quite distinct.

In this paper I shall deal exclusively with the trawl fishery for demersal fish. I shall trace in broad outline its development from the days of small sailing trawlers, limited in their operations to the southern part of the North Sea, up to the present period when the fishery is prosecuted by large and powerful steam trawlers, ranging in peace-time from the edge of the Arctic ice in the North, to Icelandic waters in the West, and the coast of Portugal in the South. I shall try to show the effect of this great expansion of the trawl fishery on the stocks of demersal fish, how these stocks have been reduced to low levels, and how over-fishing has set in; only during wars do the stocks get a chance to build themselves up.

Early History of Trawling

The story begins rather more than 100 years ago, when in the 1830's some bold spirits ventured out from the inshore waters in which trawling had chiefly taken place, to the open waters of the Dogger Bank and to the south of it, discovering the rich fishing ground of the Silver Pits, then thick with soles. These pioneers were soon followed by others, migrating from Barking, Brixham and Ramsgate, to the Humber ports of Hull and Grimsby which were later to become the premier trawling ports. A good picture of the trawl fishery in the 'sixties is given in a book by Holdsworth (1) who had visited all the fishing ports in Great Britain while acting as Secretary of a famous Royal Commission on which T. H. Huxley served. The gear then in use was the beam trawl, in which the mouth of the long conical net is held open by a wooden beam supported a few feet off the ground by iron runners or trawl heads; it is towed slowly along the bottom, and is particularly effective in taking flat-fish, such as plaice and soles. In Holdsworth's time there were about 1,000 sailing trawlers in commission, working the offshore grounds of the North Sea, principally in its southern part, but extending to the north of the Dogger and into depths up to 50 fathoms. These were small vessels with a keel measurement of 60-ft. or so, and a maximum tonnage of 70 tons net.

Trawling spread rapidly northwards and eastwards, and by about 1875 the greater part of the North Sea was being exploited by these sailing trawlers. There was little or no deep-sea trawling outside the North Sea, though in the summer-time sailing vessels using long lines ventured as far as the Faroes and Iceland.

Since the 'thirties the trawl fishery had developed from an inshore to an offshore fishery and the fleet had grown considerably. But the inroads made on the stock were not serious, and there was no sign in these days of any depletion of the stocks. The Royal Commission which reported in 1866 recommended that all restrictions on deep sea fishing should be swept away, and the industry allowed complete freedom of development. This was a wise conclusion at the time and it undoubtedly favoured the great expansion of the trawl fisheries which followed in the 'eighties and 'nineties.

*Paper read before the Royal Society of Arts, January, 1943, and reproduced, by permission, from the Society's Journal.

Introduction of Steam Power

The introduction of steam power revolutionised the industry, giving greater range and power to the fishing vessels employed, and rendering their operations in part independent of the weather, for they could work in calms and light winds when the sailing vessels were at a standstill, and also stand up to heavier weather. Steam trawlers first came into use in 1878, and their numbers greatly increased during the next 30 years, while the number of sailing trawlers rapidly decreased. Another development of importance was the substitution for the beam trawl of the larger and more efficient otter trawl, which began in 1894. In this gear, which is now universally employed by power vessels, the cumbersome beam is dispensed with, the mouth of the net being held open by the kite-like action of two large and heavy trawl-boards attached to its corners and towed at an angle over the bottom. I have no space to describe the construction and working of the otter-trawl and its modern development the Vigneron-Dahl trawl, but the reader who is interested in the subject will find a full technical account in the excellent paper on fishing gear by the late Mr. F. M. Davis (2).

Extension of Trawling Operations

The increase in size and power which followed the introduction of steam made possible a great extension in the range of trawling operations, and the use of ice for keeping the catch in good condition enabled reasonably fresh fish to be brought in from distant waters. This geographical expansion took place chiefly between 1890 and 1905. The prolific Iceland grounds were first visited by steam trawlers in 1892, those near Faroe shortly afterwards. Trawling was prosecuted right down to the Coast of Morocco in 1904, and the rich fishing grounds of the Barents Sea, to the North of Norway and Russia were first opened up in 1905. More recently, commencing about 1928, there has been a great extension of trawling, principally for cod, in the waters near Bear Island to the south of Spitzbergen.

With this extension of trawling operations to the more distant and richer waters, the North Sea has lost much of its importance as a source of demersal fish. Up to about 1890, almost all our trawled fish came from it; in the years 1903-5 it yielded about 60 per cent. of the total, and this fell to 40 per cent. by 1914. For a few years after the last war it supplied some 50 per cent., but the proportion rapidly ran down, and had fallen by 1937 to 12 per cent. In that year, the bulk of our demersal catch came from Iceland, Bear Island with Spitzbergen and the Barents Sea, the North Sea taking fourth place.

During this period of expansion, there has been an almost continuous increase in the size and power of the steam trawlers themselves, as is clearly shown in the following Table:

TABLE 1.

Average Gross Tonnage of Steam Trawlers on the Register. England and Wales, 1906-37.

Year	Tons	Year	Tons	Year	Tons
1906	177	1919	215	1928	235
1907	165	1920	221	1929	237
1908	188	1921	218	1930	245
1909	190	1922	215	1931	241
1910	190	1923	217	1932	244
1911	194	1924	225	1933	249
1912	198	1925	229	1934	255
1913	201	1926	231	1935	257
1914	207	1927	232	1936	271
				1937	284

The story then is one of continued exploition of the stocks of fish, starting in a small way on the grounds nearest at hand, and spreading out continuously to all the waters within reach, a development aided and rendered possible by technical improvements in ships and gear and the building up of the fishing fleets in ever-growing strength. It was a normal and natural development, and may be paralleled in the history of many other fisheries, such as the halibut fishery in the Pacific or the deep-sea prawn fishery in Norway.

What, then, was the effect of this great expansion of trawling upon the landings of fish and upon the vast but not unlimited stocks of which trawling takes heavy toll?

Trawling and the Stocks of Fish—continued

Statistics of the Sea-Fishing Industry

We are fortunate in possessing from near the beginning of this century very elaborate statistics of fish caught, the location of the fishing power expended, the general run of sizes, and so on, and certain less detailed information is available from 1886. I show in Fig. 1 an epitome of the landings of demersal fish in England and Wales, by British vessels, over the 52 years from 1886 to 1937, together with such information as is available about the number of steam trawlers engaged and the relation between the catch and the time spent on fishing voyages.

The black line on top gives the total landings from year to year by all methods of bottom fishing, the dotted line immediately below shows the landings by steam trawlers. It will be seen that from 1906, when the figures were first available, the landings by steam trawlers follow closely, and are not much lower than, the total landings. Steam trawling accounts for a very high proportion of the total landings of demersal fish. The finely dotted line near the bottom of the diagram represents with fair accuracy the number of steam trawlers at work in each year from 1893.

We note first of all a marked and steady increase in the quantities landed, which run up from 3⅝ million cwts. in 1886 to almost 9 million in 1907. Running up at the same time, but in the later years of this period not so rapidly, is the number of steam trawlers at work. This period is the one of rapid expansion, with growing fleets and spreading out to distant waters, to which I have already referred. It is followed, up to the outbreak of war in 1914, by a period of relative stabilisation, with total landings remaining much the same. During the war the landings fell to low levels, since fishing was greatly restricted, and most of the trawlers, and these the best, were diverted to Naval service. When they returned to fishing in 1919 and 1920, the landings recovered rapidly to a level somewhat higher than pre-war, and then till 1928 fluctuated round a level not very different from that of 1907-13.

A marked change set in about 1929, when landings began to rise, reaching a new high record in 1930, and after a slight recession, a maximum in 1937. This great increase in landings is known to be due almost entirely to the development of the great new fishery, mainly for cod, in the far northern waters in the Bear Islands, Spitzbergen and Barents Sea areas, which I mentioned earlier in this paper.

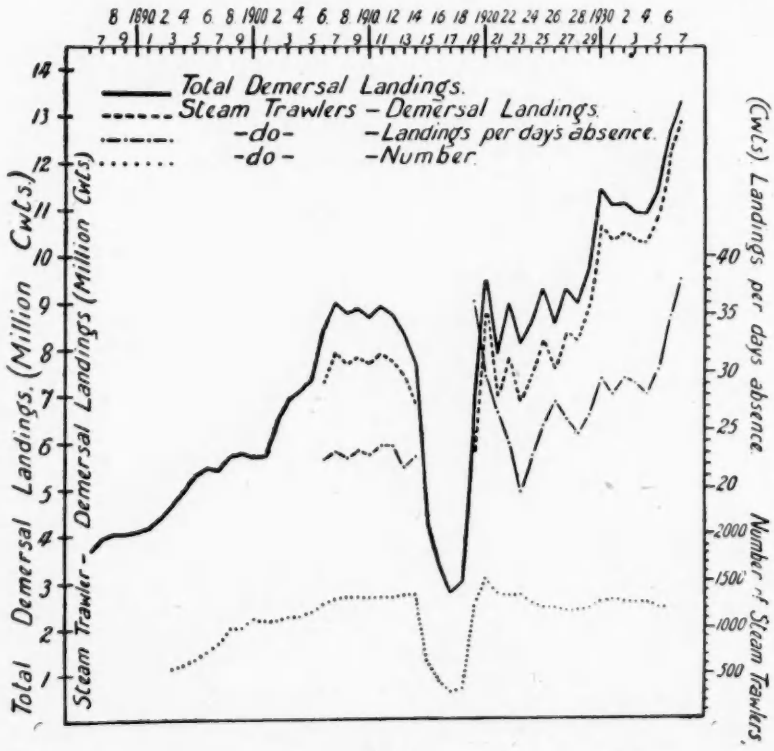

Total Demersal Landings.
Steam Trawlers – Demersal Landings.
-do- –Landings per days absence.
-do- –Number.
Total Demersal Landings. (Million Cwts.)
Steam Trawler – Demersal Landings (Million Cwts.)
(Cwts.) Landings per days absence
Number of Steam Trawlers

Fig. 1.

It will be noticed that after the war of 1914-18, the number of trawlers remains stationary or even falls a little. It must be remembered, however, that they were steadily increasing in size and efficiency; many very large trawlers were, in fact, built in the later years to work the far northern grounds. There was introduced also about the year 1923, a new form of trawl, the Vigneron-Dahl or V.-D trawl, which gave an increased efficiency of 30-40 per cent. Altogether, the catching power and the intensity of fishing increased markedly during this latest period. That the landings also increased was mainly due to the fact that the fishing shifted away from the nearer, less productive grounds, to the more distant grounds where the stock of fish was greater, and especially to the very rich cod grounds in the far north.

Differences in Productivity

The difference in productivity between the Distant, Middle and Home grounds is illustrated in the following Table, which shows also the growing importance of the Distant grounds, which include Iceland and the far northern waters:

TABLE 2.

Productivity of Distant, Middle and Home Waters, 1933-37.

Year	Total landings (unit 1,000 cwt.)			Days absent (unit 1,000 days.)			Landings per day's absence (unit 1 cwt.)		
	Distant	Middle	Home	Distant	Middle	Home	Distant	Middle	Home
1933	4,900	3,146	2,325	80	119	139	61·3	25·7	15·5
1934	5,247	2,959	2,025	85	119	144	61·7	24·6	13·1
1935	6,140	2,954	1,690	90	113	138	68·3	25·4	11·5
1936	7,530	3,106	1,494	95	112	130	79·2	27·5	11·5
1937	8,386	2,848	1,517	108	97	122	77·8	29·4	12·5

You will notice that, as judged by the landing per day's absence, the density of the fish on the grounds was six to seven times greater in the Distant than in the Home waters, the principal of which is the North Sea.

This picture of increasing landings is, however, not so rosy as it appears. The increase was mainly due to the very heavy landings of cod from the far north, which flooded the market and fetched a very poor price; there was over-production of this fish, and it latterly became necessary for those concerned in this fishery to introduce a voluntary limitation of landings, by means of quota system and by laying up vessels.

At the same time, while there was a super-abundance of cod in the north, due to natural causes beyond the control of man, for in these years there was a general warming up of the sub-Arctic waters, enabling the cod to extend their range and numbers, the stocks of other fish in the North Sea, the Middle grounds such as the area west of Scotland and Ireland, and even in Iceland, showed unmistakable signs of depletion. In these areas, the catch of haddock, hake and plaice for example, began to fall in spite of the increased intensity of fishing, or rather, as I shall show, because of the increased intensity.

Turn back for a moment to Fig. 1, and consider the dot-and-dash line that indicates the landing per day's absence. You will see that it remains fairly constant at about 23 cwts. in the period 1906 to 1914. But it shoots up by some 60 per cent. in 1919, when fishing became intensive, especially in the North Sea. Taking that area alone, our statistics show that in 1919 the average landing by English steam trawlers was 30.6 cwts. as compared with 14.3 cwts. in 1913. The density of the fish in the North Sea was therefore at least double what it had been before the war. This was a direct result of the reduced amount of fishing during the war, more fish were able to survive and grow up to a good size, and the average size of the fish caught was greater in 1919 than it was before the war. From this, and other evidence, we can conclude that the density of the stocks of fish depends very largely upon the amount of fishing to which they are subjected. When fishing is greatly reduced, as during a war, the density of the stocks rises and better catches can be

Trawling and the Stocks of Fish—continued

made. When fishing again becomes intense, the level of stocks is lowered, and the average catch becomes less. This is exactly what happened in the North Sea after the last war. The landing per day's absence fell to 25.0 cwts. in 1920, and by 1923 it had reached pre-war level. The gains of the war were rapidly wiped out through unrestricted exploitation of the temporarily increased stocks. Had it been possible immediately after the war to limit the amount of fishing, the stocks could have been maintained at a higher level, the catch per day's absence and the total yield would have been greater—and all with less expenditure of material and effort.

At that time, however, the relations between yield and intensity of fishing were not fully understood; it is, in fact, only during the last decade that these relations have become clear, through the labours of fishery research workers in many countries, including our own. There has emerged a conclusion of great practical importance, namely, that in most fully-developed fisheries a state of over-fishing has been reached, a state, that is, where the ever-increasing intensity of fishing has resulted, not in an augmentation of the catch, but in a diminution. To give the full evidence for this conclusion would occupy much more time than I have at my disposal, and I have already set out in some detail in a small book published last year (3). I shall therefore limit my remarks to one fish only, the haddock, where the evidence is particularly clear-cut and straightforward. What I say about the over-fishing of the haddock stocks is, however, applicable, *mutatis mutandis*, to other commercially important demersal species, with the possible exception of the cod in northern waters.

The North Sea Haddock Fishery

Let us consider first the haddock fishery in the North Sea. A clear indication of the diminishing density of the stock is afforded by Table 3, in which is displayed the average landing per day's absence from port by English steam trawlers over the period 1906-1937, with the exception of the war years, 1915-18, when this information was not available:

TABLE 3.
Haddock.
Landing per day's absence by English Steam Trawlers from the North Sea, 1906-37.

Haddock	cwt.	Landing per day's absence by English Steam Trawler from the North Sea, 1906-37	cwt.		cwt.
1906	7·8	1919	15·8	1929	5·2
1907	7·8	1920	10·9	1930	6·3
1908	6·9	1921	9·6	1931	4·8
1909	5·9	1922	8·5	1932	4·5
1910	4·9	1923	5·4	1933	4·6
1911	5·3	1924	4·8	1934	2·7
1912	4·7	1925	8·5	1935	1·9
1913	3·0	1926	8·2	1936	2·1
1914	4·6	1927	5·9	1937	2·6
		1928	5·4		

In the period of eight years, 1906-1913, there is a downward trend in the values for landing per day's absence, indicating a slow diminution of the stock; the average for this period is 5.8 cwt. In the first year after the war we get the very high value of 15.8 cwt., and the mean of 1919 to 1921 is still high at 12.1 cwt. Clearly the stock had greatly increased owing to the reduction in fishing during the war. But it became rapidly reduced in the three ensuing years through the resumption of intensive fishing, and by 1922 it had reached a level not much above that of 1906-1907. If we assume that the war effect had been wiped out by the end of 1921, and group the remaining 16 years in two eight-year periods, we find that the average value of the landing per day's absence was, in 1922-1929, 6.5 cwt., but in 1930-1937 only 3.7 cwt. It is clear that the density of the stock was much reduced in the later period, and a glance at Table 3 will show that the decrease was, on the whole, progressive, very low values being reached in 1934-1937.

It so happens that the English figures show the change in the density of the stock with particular clarity, because they relate mainly to the middle and southern parts of the North Sea, where the depletion of the stock is most marked. The change is not so great in the northern part, which is the headquarters of the haddock stock, and is fished more by Scottish than by English trawlers. A more comprehensive view of the haddock fishery in the North Sea as a whole can therefore be obtained by considering the combined statistics of the English and the Scottish fisheries. These together take the lion's share of the haddock fishery, accounting for more than three-quarters of the total landings by all countries from the North Sea. The data relating to the combined British landings, which are set out in Table 4, may therefore be taken as fully representative of the course of this fishery, and its effect upon the stock of haddock, since 1920:

TABLE 4.
Statistics of the English and Scottish Steam Trawler Fishery for Haddock in the North Sea, 1920-37. Average values for 3-yearly periods.

Years	Quantities landed. Unit 1,000 cwts.	No. of hours' fishing. Unit 1,000 hours	Landing per 100 hours' fishing	Landing per day's absence
1920-22	2,425	—	—	10·8
1923-25	1,559	2,747	57	7·3
1926-28	1,649	2,464	67	8·8
1929-31	1,565	2,564	61	8·1
1932-34	1,359	2,547	53	8·1
1935-37	888	2,453	36	6·6

The figures show that there has been, since the 1926-1928 period, a steady fall in the quantities landed, of such a magnitude that in the 1935-1937 period the yield is only 54 per cent. of the 1926-1928 average. At the same time there has been a marked decrease in the yield per unit of fishing time, shown very clearly in the fall of the landing per 100 hours' fishing from 67 cwt., in 1926-1928 to 36 cwt. in 1935-1937. There has therefore been a considerable decrease in the density of stock in the North Sea, as measured by weight.

Now, during the years in question there was no slacking off of the fishing. The number of hours' fishing remains very much the same during the 12 years from 1926 to 1937, and actually the intensity of the fishing was greater in these years than previously, because of the adoption between 1923 and 1926 of the Vigneron-Dahl trawl, which improves catching power by at least 30 per cent. Direct evidence has been obtained by Scottish investigators that the rate of depletion of the haddock stock through fishing has been greatly increased since the introduction of this improved gear. This increased rate of depletion has, not unnaturally, been accompanied by an increase in the growth-rate of the fish. Indirect evidence of increased mortality rate is provided by the fact that the proportion of large fish in the catch has been falling, while the proportion of small fish has been mounting.

There has taken place, therefore, since about 1923, a marked increase in the intensity of fishing, a decrease in the density of the stock, and a great diminution in the total yield of the fishery. It should be added that the reduction in yield shown by the British figures is reflected also in the International statistics. For the period 1922 to 1929 the average annual landings of haddock by all countries that fish the North Sea was 128 million kilos, while for the period 1930 to 1936 it was just under 94 million kilos. The conclusion is inevitable that increased intensity of fishing has resulted, not in an augmentation, but in a diminution of total yield. That is over-fishing.

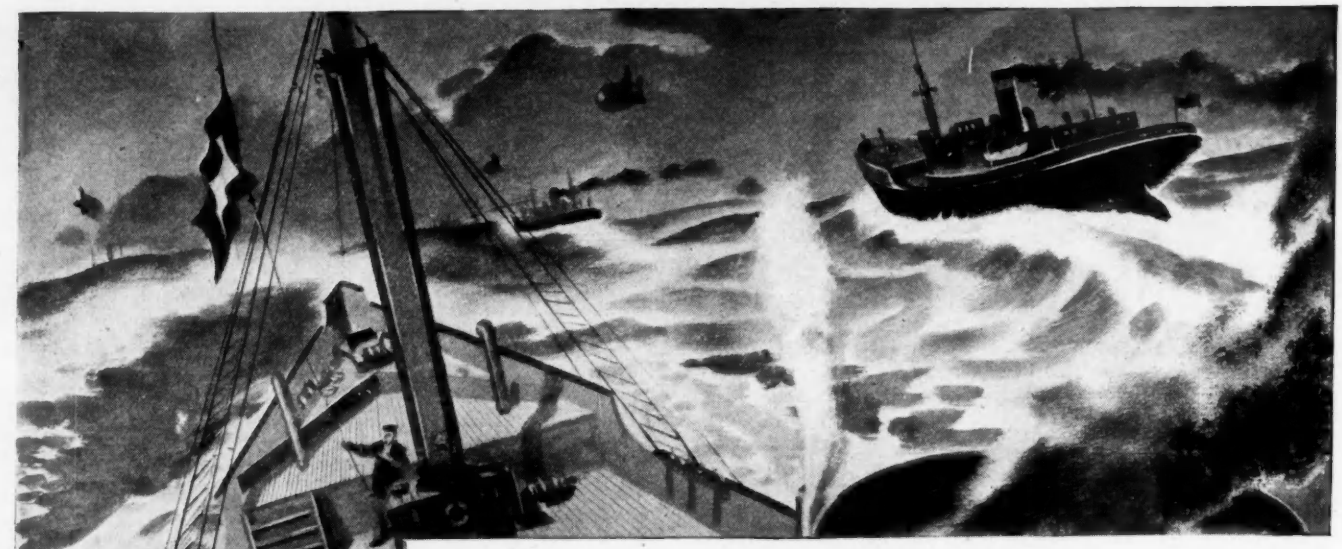
(To be continued)

United States Port Appointments.

Commissioner Frank Dorsey has been re-appointed by the Governor of the State of New Jersey as a representative of the State on the Port of New York Authority. He was at one time a member of the New Jersey State Board of Commerce and Navigation.

Mr. M. H. Meade has been appointed a member of the Board of Harbour Commissioners of Milwaukee, Wisconsin, in place of Mr. R. S. Falk, who has resigned.

Admiral Cyrus W. Cole, United States Navy (retired) has been reappointed to the Board of Harbour Commissioners, San Diego, California.



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